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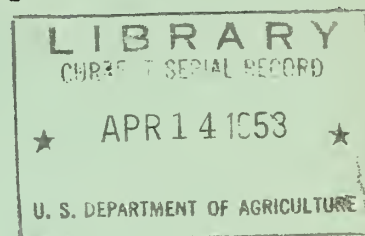


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<sup>50</sup>  
MARCH 1958

The agricultural needs of

GUAM



Mariana Islands,

Report of a

United States

Department of Agriculture

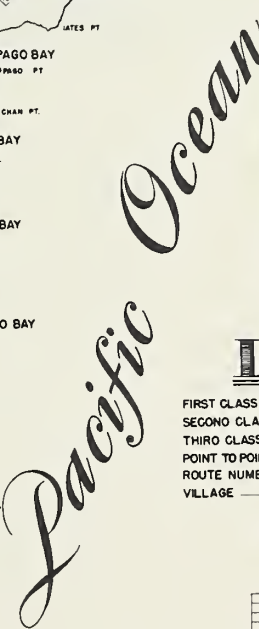
Survey Group

UNITED STATES DEPARTMENT OF AGRICULTURE

(U.S. Agricultural Research Service,

ARS - 24 - 3)





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**NOTE**

WR 1948

GUAM/N2-1/11152

Navy—PPO Guam.



This report was prepared by a United States Department of Agriculture group named to survey the agricultural needs of Guam. This group examined Guam's agricultural problems and potentialities as of October 1956. It was made up of the following members:

Chairman.--David V. Lumsden, Agricultural Research Service  
Fred C. Jans, Federal Extension Service  
Nathan Koenig, Agricultural Marketing Service  
Tom F. McGourin, Soil Conservation Service  
Willard C. Wakefield, Agricultural Research Service



## Preface

For more than half a century the United States Department of Agriculture has had varying degrees of responsibility for the agriculture of Guam.

In 1907 the Secretary of the Navy formally requested the Secretary of Agriculture to cooperate in attempting to improve the agricultural conditions of the island (1, p. 405). 1/ This was initiated to supplement the work of an agricultural experiment station which had been organized in 1905 under the local government. For the fiscal year 1909 the Congress made an appropriation of \$5,000 available to the Department for the establishment of an agricultural station on the Island of Guam (2, p. 28). From 1908 to 1932 the Department's activities are well documented in the U. S. Department of Agriculture's annual reports of agricultural experiment stations and in the annual reports of the Guam Agricultural Experiment Station, which was under the supervision of USDA's then existing Office of Experiment Stations. In the USDA Report on The Agricultural Experiment Stations, 1932, this statement appears, "In pursuance of a policy of retrenchment, coordination, and greater local participation in administration, a policy which has been developing for some time, the Department of Agriculture discontinued direct operation of experiment stations in Alaska, Guam, and the Virgin Islands on July 1, 1932." There is little evidence that any extensive agricultural program was conducted locally on Guam from 1932 until after the passage of the Organic Act in 1950.

Following World War II increasing interest in the agricultural problems and potentialities of Guam and the Trust Territory of the Pacific Islands has been apparent. Prior to 1947 a number of proposals for agricultural assistance to these Pacific Islands were submitted, culminating in "A Proposed United States Agricultural Program for the Trust Territory of the Pacific Islands" submitted December 1, 1947, by the Secretary of Agriculture to the Secretary of the Navy (3, p. 1).

In 1950 another proposal was drawn up in response to a request from the Secretary of the Interior to the Secretary of Agriculture. This 1950 proposal, entitled "Proposed Plan for an Office of Agricultural Services for United States Island Possessions and Trust Territory of the Pacific," dated December 14, 1950, by Glen Briggs, suggested that the 1947 proposal might be too ambitious. The 1950 proposal, which included Guam, American Samoa, and the Trust Territory of the Pacific, outlined total budget estimates of \$621,400 per annum. It recommended that the Secretary's Office appoint an agricultural committee to visit the islands concerned and make recommendations and a final plan.

1/ Underlined numbers in parentheses refer to References, p. 45.



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THE AGRICULTURAL NEEDS OF  
GUAM, M. I.

INTRODUCTION

The following report resulted from action taken by the U. S. Department of Agriculture as a consequence of legislation that was being considered by Congress as a result of the report made by the Commission on the Application of Federal Laws to Guam on July 30, 1951. This legislation sought to implement section 25(b) of the Organic Act of Guam by carrying out the recommendations of the Commission. <sup>1/</sup>

On April 4, 1956, in a report on the agricultural phases of a pending bill (H. R. 6254, 84th Congress) to the Chairman, Committee on Interior and Insular Affairs, House of Representatives, the Acting Secretary of Agriculture stated, "Although we agree with the objectives of the bill, this Department recommends against enactment of the proposed legislation in its present form. Excessive costs and difficult administrative problems would be involved in extending to Guam these laws, which were designed for application to large agricultural areas. Moreover, there may be special needs in Guam which would not be adequately covered by these general laws. It would appear that a small agricultural staff, specializing on the peculiar needs of Guam could better meet the needs of that island."

As a result, the bill was amended to delete reference to practically all agricultural items, thus leaving the way open for subsequent legislation to cover the agricultural needs of the island.

On January 23, 1956, the Department of the Interior directed a letter to the Department of Agriculture as follows:

My dear Mr. Secretary:

In a report to the Bureau of the Budget, dated February 21, 1955, the United States Department of Agriculture recommended against the extension to Guam of certain laws relating to Federal agriculture programs as proposed in a bill which would implement section 25(b) of the Organic Act of Guam by carrying out the recommendations of the Commission on the Application of Federal Laws to Guam.

<sup>1/</sup> See Appendix A, p. 46.

The Honorable Ford Q. Elvidge, Governor of Guam, in commenting on your recommendation called attention to the imperative need for a special Federal agricultural program which would apply to Guam and referred to your offer to assist in developing such a program. The advantages derived from close cooperation between your department and the Government of Guam would be most beneficial if it could help assure the availability of specialists on Guam and make available the research facilities of your department in the consideration of problems related to the agricultural development on Guam.

In this connection there is outlined below a list of some of the more urgent programs worthy of United States Department of Agriculture assistance and cooperation:

1. Drug plant introduction, cultivation, and processing.
2. Animals and facilities for producing, processing and marketing dairy products.
3. Introduction and testing of pasture and forage plants for grazing.
4. Meat processing and marketing.
5. Soil improvement and erosion control in the hilly, volcanic areas.
6. Biological control of crop and livestock pests.
7. Determination of agricultural diseases and insects to be excluded from Guam by Federal quarantines.
8. Organization and supervision of farmer production and marketing cooperatives.
9. College-level training in agricultural sciences for Guamanians who would later serve Guam.

Of the above listing the dairy, cooperative marketing, and education programs are most important.

The Governor of Guam has estimated that a minimum annual Federal appropriation of \$30,000 to the United States Department of Agriculture would be necessary to begin such a program. He has also indicated that the local legislature would give prompt consideration to legislation which would provide local funds to match this amount.

I shall appreciate your consideration of these exploratory proposals as they relate to the agricultural needs of the Territory of Guam, and I join with the Governor of Guam in welcoming the proffered cooperation of the United States Department of Agriculture in meeting these needs. I shall also be glad to arrange for members of my staff in the Office of Territories to meet with representatives of your Department to explore the establishment of a working relationship between your Department and the Government of Guam.

Sincerely yours,

/s/ Wesley A. D'Ewart

Assistant Secretary of the Interior

The following response was made to the above letter:

June 8, 1956

Hon. Wesley A. D'Ewart  
Assistant Secretary of the Interior

Dear Mr. D'Ewart:

Consideration has been given your letter of January 23, 1956, concerning the agricultural needs of Guam. In the interim, attention has been directed to exploring ways and means of rendering cooperation between this Department and the Government of Guam. Several meetings have been held here to study your letter, and we have met with representatives from your Department to further this activity. We have now reached the point where definite plans can be developed leading to the drafting of suitable legislation for an agricultural program for Guam.

We propose to organize a survey group from this Department which will visit Guam and study the present agricultural status of the island and determine the needs of the people in the light of your request, and that of the Governor of Guam. We expect to confer further with your Department and also with others from this Department who can contribute to the success of this mission.

It is our desire to make adequate and thorough preparation for this survey. We estimate that our group will be well prepared for the trip to Guam in the late summer or early fall. This will give time to complete a report and draft suitable legislation for the next Congress. Tentatively, we contemplate having this study group comprise up to four men representing the areas of agriculture we deem most apt to require investigation and for which constructive recommendations will be made.

The action outlined above will follow to a degree a similar course that we followed in setting up an agricultural research and extension program for the Virgin Islands which culminated in the passage of Public Law 228 of the 82d Congress. We propose to pay the travel and subsistence expenses of the survey group while en route to Guam and return to Washington. We have been advised that the Governor of Guam has offered to arrange for subsistence and lodging and any travel that will be required while the group is on the Island of Guam. Certainly such assistance on his part would be most helpful in connection with carrying out the proposed survey.

Please let us have your reaction to the above recommendations. In the meantime, we will go forward in developing detailed plans for the proposed survey.

Sincerely yours,

/s/ E. L. Peterson  
Assistant Secretary

Concurrent with the above exchange of letters the Agricultural Research Service was designated by the Secretary's Office to take the lead in considering the basic request. Dr. David V. Lumsden, Director of the Territorial Experiment Stations Division, was named as chairman of a working group to develop details of an action plan within the framework of the recorded developments and with the understanding that the travel expenses of a survey group would be paid by the agencies represented. The agencies of the USDA notified to name representatives to constitute the working group are as follows: Agricultural Marketing Service, Farmer Cooperative Service, Federal Extension Service, Forest Service, Soil Conservation Service, Office of Budget and Finance, Farmers Home Administration, Office of the General Counsel. Several meetings of this group were held with Mr. William A. Arnold, Assistant Director (Insular Affairs), Office of Territories, and others from the Department of the Interior in attendance as occasion required.

After a full discussion of the problem, the following were named by the agencies of the USDA to constitute the survey group that spent three weeks on Guam to study its agricultural problems and potentialities:

David V. Lumsden, Agricultural Research Service, Chairman  
Fred C. Jans, Federal Extension Service  
Nathan Koenig, Agricultural Marketing Service  
Tom McGourin, Soil Conservation Service (From Honolulu)  
Willard Wakefield, Plant Quarantine Branch, 2/  
Agricultural Research Service (From Honolulu)

The members of this group stationed in Washington held several additional meetings, some of which were attended by Mr. Arnold and other representatives of the Department of the Interior, to develop details and gather facts of value for the contemplated survey. Late in September 1956 all plans for the survey were completed.

### Contacts

#### Honolulu

En route to Guam the survey group stopped in Honolulu where on September 28 a meeting, arranged by Mr. McGourin, was held to discuss with various informed governmental officials and others many of the agricultural factors that might be considered as the

2/ Ivan Rainwater was authorized by this Branch to assist in the survey during its final week on Guam.

survey progressed. In attendance at this meeting, in addition to the five members of the survey group, were:

H. S. Dean, Plant Quarantine Branch, Agricultural Research Service, Washington, D. C.  
Dan A. Davis, District Geologist, Ground Water Branch, United States Geological Survey, Honolulu, T. H.  
Vernon E. Brock, Board of Agriculture and Forestry, T. H.  
Howard S. Leak, District Engineer, Surface Water Branch, United States Geological Survey, Honolulu, T. H.  
Kenneth L. Maehler, Plant Quarantine Branch, Agricultural Research Service, Honolulu, T. H.  
Marshall M. Ross, Plant Quarantine Branch, Agricultural Research Service, Honolulu, T. H.  
Dr. Alexander Spoehr, Director Bishop Museum, Honolulu, T. H.  
Alan Thistle, Director Division of Entomology and Marketing, Board of Agriculture and Forestry, Honolulu, T. H.  
H. H. Warner, Former Extension Director, University of Hawaii Extension Service, Honolulu, T. H.

At this meeting those who had had agricultural experiences on Guam related their findings and made suggestions that might prove helpful to the survey group.

#### Guam

While on the Island of Guam the survey group met with representatives of a considerable number of governmental and commercial agencies, as well as with private individuals, to discuss local agricultural problems and to gather information for the survey.

A meeting was held with the Governor, his staff, and department heads shortly after the arrival of the survey group on Guam. The group was oriented regarding the operation of the Guam Government and the functions of the various departments of the government. Arrangements were made for further meetings with representatives of the departments concerned in the agricultural survey.

Headquarters of the Trust Territory of the Pacific Islands were visited and Jack Wheat, agriculturist, and John M. Spivey, administrative officer, explained the mission of that organization, particularly the agricultural relationship of the Trust Territory to that of Guam. Knowles Ryerson, U. S. Commissioner of the South Pacific Commission, was in attendance at this meeting.

The Commander of Naval Forces of the Marianas, Rear Adm. W. B. Ammon, USN, met with the survey group, at which meeting the agricultural mission of the group was discussed. This led to a second meeting at which the survey group, members of the Guam Department of Agriculture, an Air Force officer, and officers and officials of the U. S. Navy discussed the problems of the procurement of agricultural commodities and services for military and civilian personnel associated with naval activities on Guam. Through the Governor of Guam, Naval headquarters arranged for helicopters so that members of the survey group could study some of the agricultural problems of the island from the air at low elevations.

Similar contact was made with the U. S. Air Force headquarters on Guam. The group met with Col. Frank E. Marek, Base Commander, Andersen Air Force Base, to discuss the mission of the group. Later a 1-day visit was made to the Base by the group, members of the Guam Department of Agriculture, and a number of Guamanian farmers. A full discussion of Air Force procurement of agricultural commodities was held with Air Force procurement officers and other officials. A tour of the warehouses, cold storage plant, and commissary was conducted to acquaint those present with the problems of the procurement of agricultural commodities used by the personnel of the Base. A discussion initiated plans whereby better marketing coordination could be effected between the farmers of Guam and Air Force procurement officials through the Guam Department of Agriculture.

A visit was made by the survey group and Guam Department of Agriculture officials to the manufacturing plant of the International Dairy Supply Company. Under contract with military agencies, this plant reconstitutes milk and manufactures other dairy products, including ice cream and cottage cheese, for military establishments on Guam; limited supplies are also available for civilian distribution.

Officials in the headquarters of the Guam Department of Land Management and the U. S. Geological Survey were consulted regarding the status of soil surveys and land management activities on the island. Various documents and soil maps were made available for the survey from these sources.

A meeting with the Director of the Guam Department of Education, the Superintendent of Schools, and other school officials was held in the George Washington High School headquarters. Here the status of agricultural education on Guam was discussed with the school officials and members of the Guam Department of Agriculture.

The survey group also met with the Speaker of the Guam Legislature, the Honorable Francisco B. Leon Guerrero, and the Legislature's Committee on Agriculture and Natural Resources. This committee called the attention of the survey group particularly to the menace of insect and disease pests to the development of a greater agricultural industry on the island. The need for simplified legislation for the encouragement of agricultural cooperatives was discussed, also the potentialities

of reviving the coconut industry of Guam through improved mechanical processing methods. The Speaker of the Guam Legislature remarked that he had been employed in the old U. S. Department of Agriculture Experiment Station at Piti, activities of which were terminated in 1932.

In addition to the above cited sources of information several field trips were made to the Guam Department of Agriculture Demonstration Farms at Yigo and Talofoto and to the farms and homes of a number of Guamanians throughout the island.

## GUAM, BACKGROUND INFORMATION

### Political History

The Island of Guam was discovered by Magellan in 1521. Other Pacific explorers stopped there subsequently, but Spain exercised sovereignty from the time of Magellan's landing until Guam was captured by the United States in 1898 during the Spanish-American War. The United States then assumed jurisdiction, and a new era began for the Guamanians.

From December 1941 until July 1944 Japanese forces occupied Guam, and the present development of the island dates back to Liberation Day, July 21, 1944.

Except for the period of Japanese occupation, the affairs of Guam were administered by the Secretary of the Navy from 1898 until August 1, 1950. At that time jurisdiction over civilian affairs of Guam was transferred from the Department of the Navy to the Department of the Interior. An Organic Act was drafted to provide for a civilian government. The act was passed by the Congress of the United States and became effective upon approval of the President on August 1, 1950. By the terms of this act of Congress, Guam became a Territory of the United States.

General responsibility over the civilian affairs of Guam is vested in the Secretary of the Interior with the Office of Territories in the Department of the Interior charged with assisting in carrying out this responsibility. The Office of Territories has two broad objectives for all the Territories for which the Secretary of the Interior is responsible. These objectives are: (1) To promote the economic, social, and political development of the areas, and (2) To further international peace and security by conducting Territorial affairs in close coordination with the defense policies of the United States. The degree to which the Office of Territories conducts activities to further these objectives in a specific Territory depends on the status of the Territorial government, its relationship to the Secretary of the Interior, and the extent of development already achieved within the Territory.

Under these broad objectives the Department of the Interior, through the Governor of Guam, exercises supervision of, and acts as a coordinating agency for, the Federal civilian activities in Guam. The Office of Territories, through the Secretary of the Interior, is the principal agency responsible for the development of Federal territorial policy, and advises the President and the Congress on all aspects of this policy.

### Physical Resources

#### Area and Topography

Guam is the most southerly, and most important, of a group of islands in the western Pacific Ocean dispersed over 420 miles from latitude 20°30' north, longitude 143°46' east to latitude 13°14' north, longitude 142°31' east. The archipelago is known as the Mariana Islands. Guam is situated in about the same latitude as Guatemala. All of the islands are of volcanic origin and each is fringed with a coral reef. Smoke still issues from live volcanos on some of the more northerly islands of the chain, but Guam contains no active or live volcanos.

Guam is about 5200 miles from San Francisco, 3300 miles from Honolulu, 1500 miles from Manila, and 1300 miles from Yokohama.

The total area of Guam is about 225 square miles. It is about 30 miles long, 8 to 9 miles across in the northern and southern parts, and 4 miles across in the center (in the vicinity of Agana).

The northern half of the island is a flat plateau, or mesa, which averages about 300 to 400 feet above sea level. This area is broken by only a few low hills. This elevated plateau drops precipitously on three sides directly to the sea or to a narrow beach area slightly above sea level.

The southern half of the island is mostly hilly and rugged. Mt. Lamlam, the highest mountain, rises to a height of 1334 feet. Considerable erosion is apparent throughout this area, and the topsoil has been washed down to form level fertile areas along the river valleys.

#### Climate

Guam has a pleasant, tropical climate. Temperatures are fairly even throughout the year--they range from 70° to 90° Fahrenheit. The average rainfall is about 87 inches; three-fourths of this falls during the wet season, from June through November. 3/

3/ See Appendix D, Table 1.

Guam, which is in the typhoon belt, has infrequent destructive storms with winds in excess of 100 miles per hour. An extensive typhoon warning system, which has been instituted by the armed services, warns the people in advance of dangerous disturbances so that personal and property damage can be kept at a minimum.

As is true on many tropical islands, altitude influences the amount of rainfall at any given location, which in turn affects its agricultural potentialities. <sup>4/</sup>

### Soils <sup>5/</sup>

The soils of the island vary in different regions from a fine coral sand along the beaches, to light reddish loam underlaid with coral limestone on the mesas, to deep black adobe-like clay along the rivers and in the deeper valleys in the southern half of the island.

The northern half of the island consists almost entirely of a raised platform of porous, coralliferous limestone. There are several springs in the area, but no streams. The surface is covered with a layer of soil, often only a few inches deep, of a reddish color caused by the presence of oxide of iron from the decomposition of coral. Beneath this topsoil is a layer of rotten coral over the ancient reef--a solid mass of hard coral. The porosity of this coral limits its agricultural use through a lack of water-holding capacity.

On the higher parts of the island, which make up most of the southern half, are extensive savanna areas with scant vegetation. The soil here is red clay, which is very sticky when wet, drains poorly, and has little or no organic matter. This clay can be made to yield crops, however, by cultivation and addition of organic matter.

The best soils on Guam are those found in the low-lying valleys. On the east side of the island the valleys of the Talofofo, Geus, Inarajan, and of several other rivers are noteworthy for their good alluvial soils. Although these areas may be flooded during the rainy season, they are more productive than higher areas that are seasonally low in soil moisture. There is a limited area of fertile soil on the northern plateau of the island near Mt. Santa Rosa in the Yigo-Mataguac vicinity where the porous coralliferous limestone mesa is pierced by volcanic outcrops.

<sup>4/</sup> See Appendix D, Table 2.

<sup>5/</sup> For a technical description of the soils of Guam see Appendix B.

## Vegetation

The vegetation of the island varies from dense jungle-type cover to open grassland. More than 3/4 million coconut trees are scattered throughout the area. Screw pine, breadfruit, and tangantangan grow well in most areas, particularly in the valleys, stream bottoms, and along the high-ways and roads. The savanna area is covered with grass--mostly sword grass--of varying density, depending on the soil characteristics and moisture content for any given location.

Below is a list of the predominant vegetative plants:

Coconut	Papaya
Screw pine ( <u>Pandanus</u> )	Banana
Breadfruit ( <u>Artocarpus</u> )	Hilo grass ( <u>Paspalum conjugatum</u> )
Tangantangan ( <u>Leucaena glauca</u> )	Sword Grass ( <u>Miscanthus floridulus</u> )
Ironwood ( <u>Casuarina</u> )	Paragrass ( <u>Panicum purpurascens</u> )
Pago ( <u>Hibiscus</u> )	Marsh reed ( <u>Trichoon roxburghii</u> )
Banyan ( <u>Ficus</u> )	Ferns (various)
Ifil ( <u>Instra</u> )	A foxtail grass ( <u>Pennisetum</u> <u>Palyatchyon</u> (L.) Schult

## Human Resources

The impact of both a European and an American culture on the natives of Guam has resulted in customs and a way of life not found elsewhere in the other islands of the South and West Pacific Ocean. For this reason it is more fitting to use the appellation "Guamanian" than to refer to the people of Guam as "Chamorros," a generic name of primary interest to anthropologists.

Average Guamanians of today are mixtures of many nationalities, including Spanish, American, Filipino, Japanese, Chinese, and German. This is the result of the island's having been under the rule of and association with various countries in the past. Because of the Guamanian's sensitivity to influences that have come to the island, the final result of Guam's history of migrations, impression of foreign cultures, and subjugation by various countries is a race of people that has almost lost its basic characteristics.

Guamanians range in color from light to dark and in height from short to tall. Their features range from those of the European to those of the Micronesian.

A census of Guam as of June 30, 1956, indicated the number of Guamanians and aliens on the island to be 35,844.<sup>6/</sup> The population for all those engaged in military activities is transitory, but the 1950 Census of Guam shows a total population of 59,498. This, according to the census study, gives a population density of 293 inhabitants per square mile.

For historical purposes the U. S. Census figures are given below from the time that the United States gained possession. These figures have little value, however, in studying the needs and potentialities of the island for, since 1944, all signs point to a new role for Guam as a functional outpost of American and world civilization.

The following figures from the U. S. Census of Population: 1950 show the population of Guam from 1901 through 1950:

1901	9,676
1910	11,806
1920	13,275
1930	18,509
1940	22,290
1950	59,498

#### Modern Facilities

Recognition of the importance of Guam since World War II has brought many modern facilities to the island. Guam has a fine harbor, which for security reasons is presently under Navy control. A network of hard-surfaced, two-, three-, and four-lane highways, totaling over 80 miles, connects the more important installations on the island. Over 65 miles of improved secondary roads are available to vehicular traffic completely along the near-periphery of the land area. A telephone system provides service for the military and those in the more urban region. Electric power for the military service is available in limited quantities for civilian use, as are water, sanitary systems, and other modern public utilities. Medical and public safety facilities are being developed rapidly. Provision of ample educational opportunities has been given considerable emphasis.

A large general hospital is nearing completion, of which the 160-bed tuberculosis hospital portion was dedicated in 1955. The Navy also has a very large hospital on the island. There is, also, a very active and well-staffed Public Health Service.

In addition to many small local stores in the villages, islanders have access to a number of very good shops and suppliers in Agana and elsewhere. Several modern farm machinery and farm supply stores exist. The Guam markets seem surprisingly well-stocked to meet many of the modern wants of man. Although a considerable amount of new mechanical equipment is available, it is reported that difficulties are encountered in the repair and replacement of worn and damaged equipment.

<sup>6/</sup> See Appendix D, Table 3.

### Economy

Guam's economic status cannot seemingly be improved greatly through natural resources. On the island there are, at present, no appreciable mineral resources, no large-scale forests, no abundant supplies of fish, and no great interest in fishing in the sea adjacent to Guam. So long as it is necessary for security reasons to limit entry of tourists, Guam cannot anticipate an industry based on tourism.

Both before and immediately after World War II, security measures to safeguard United States expanding defenses in the Pacific, tended to curtail the development of free civilian enterprises on Guam. Limitations of movement of peoples, goods, and services into and from the island have aggravated long-existing problems of an island relatively new to and remote from the States.

Guam is, has been, and will continue to be, of the utmost importance to the United States and its Department of Defense. Located halfway between Japan and Australia and less than 1500 miles east of the Philippines, the strategic significance of this island is readily apparent. In addition to its strategic geographic location, Guam offers to the military favorable all-year flying weather and an excellent, well-protected harbor.

As a direct consequence of these conditions and as a result of the development of this Pacific outpost, the pre-World War II subsistence agricultural economy has been replaced by a purely service economy. The military forces and the development of bases and housing, as well as other facilities and services, provide a wide range of employment opportunities for the people of Guam. In fact, the demand for labor and other personnel has been so great that workers have had to be brought in from other sources, in large but diminishing numbers, since needs could not be met from the local work force. Thus, the military is a major element of competition which the civilian employer finds himself up against in the hiring of workers.

Altogether, Guam contains approximately 142,058 acres of which 49,408 acres are under military holdings, 31,650 acres are under the control of the Territorial Government, and 61,000 acres are privately owned. The military holdings include a considerable acreage of land suitable for agriculture. This acreage, however, is not readily available for farming purposes as long as it is held by the military. Land under the control of the Government of Guam is being made available for rehabilitation purposes, including home construction, business and industry, and agriculture. Such land for agricultural purposes is being made available by the Guamanian Government through land-use permits, only on a year-to-year basis, until such time as surveys

can be completed and private claims settled which would make it possible to furnish a good deed. Of the total land privately owned, a considerable acreage is in large holdings, and these lands are for the most part idle, except for some grazing and temporary use for limited production.

The past and present of land-use on Guam and how it affects the economy of the island was the subject of a special study by the Department of the Interior in 1950 (4). 7 Some of the findings in this report pertaining to agriculture have been utilized in the study and recommendations reported herein.

### Agriculture

Agriculture on Guam is very much underdeveloped. Large areas of land that could be used for agricultural purposes are idle and grown up in jungle. Except on a few farms, production practices are for the most part crude. Quite often land is cleared, used for a single crop, and then permitted to grow back to jungle. The farmer then follows through with the same cycle on another piece of land. In growing crops, most farmers use little or no fertilizer. Those who do use fertilizer have started this practice only recently. Somewhat more farmers use insecticides and pesticides, but very few follow any regular schedule for the application of these products for systematic control of insects and other pests. The use of insecticides and pesticides, like fertilizers, is relatively new to the Guamanian farmers and the surface of use is not even scratched.

Guamanian agriculture is characterized by small farms and small-scale operations. Although there are some large landowners, most of the agricultural production comes from the family-operated small farm. 8/

The Guam Department of Agriculture reports for the 1956 fiscal year that there are less than 700 full-time farmers on the island. An estimate is made that approximately 3,400 families produce some of their own food even though employed part- or full-time on nonfarming jobs. The 1950 "Agricultural Census" gives Guam a population total of 58,754 in the 15 listed municipalities and a total of 2,262 farms. The average size farm is reported to be about 10 acres. However, the few large farms reflect the very small acreages of the balance. In that census, "places were counted as farms if any crops were grown in 1949 or if any livestock or 5 or more chickens or other poultry were kept on April 1, 1950." To further complicate the problem, titles to holdings of land ready for release by the Territory of Guam are being legally questioned and await court decisions.

Agriculture on Guam must be considered in relation to total civilian employment. Not only has the available local labor force, including rural people, proved inadequate, but military activities made it necessary to import a number of aliens to augment it.

7/ Underlined numbers in parentheses refer to References, p. 45.

8/ See Appendix D, Table 4.

The military buys its commissary supplies largely in the United States West Coast areas, but does not need to add shipping costs in its cost of operation. This seems to put the local producer at a decided disadvantage. However, spoilage of perishables from the States is quite high and this, plus extra handling, makes local products of similar kind and quality desirable to military purchasers.

Ample evidence exists of the need to encourage further improvement of local production. However, a severe lack of marketing knowledge shows up frequently. Many local people feel they should be paid extremely high prices, regardless of quality or quantity. Very few, if any, producers know what their production costs are. Some varieties of bananas are not wanted by the stateside servicemen's families. Little effort, until recently, was exerted to advise local producers what might be wanted by military buyers; producers, on the other hand, failed to advise the military what they had planted and when and how much could be delivered. Containers for agricultural produce are expensive, and conserving available packaging materials will be of material help, especially to small producers.

It is against the background of the Guamanian people, their land, and the present-day economy, which is so greatly influenced by the military, that any action for the development and improvement of agriculture on this island must be considered. In this connection, emphasis needs to be given primarily to what the Guamanians can do for themselves with the Federal Government merely supplementing these efforts and, where necessary, assisting in bringing about desirable shifts and readjustments, but not going beyond the agricultural capabilities and potentialities that the Guamanians have.

### Administration

#### The Government

On August 1, 1950, the Congress of the United States passed the Organic Act whereby Guam was made a Territory of the United States. The Organic Act created the traditional government of three branches--executive, legislative, and judicial. It provided for a Governor and a Secretary to head the executive branch, both appointed by the President of the United States, the Governor by and with the advice and consent of the Senate of the United States, and each to serve a 4-year term. The act further provided for the appointment of all heads of executive agencies and instrumentalities by the Governor, by and with the advice and consent of the Guam Legislature.

Other provisions of the act authorized a unicameral legislative assembly limited to 21 members and a judiciary branch in the form of the district court of Guam and such other courts as the Guam Legislature may subsequently establish.

The act made certain provisions benefiting the new Territory that are significant for the purpose of this report. American citizenship was extended to Guamanians, and a bill of rights was included equivalent to those in the National and State constitutions. It also provided that the income tax laws in force in the United States, and those which hereafter may be enacted, shall be held to be likewise in force in Guam--and that all taxes and duties collected on the island be covered into the treasury of Guam for use by the Government of Guam.

The additional authority and responsibility given the Government of Guam made possible a different kind of economy and way of life for Guamanians.

The Governor, chief executive of the island, administers affairs of the Government of Guam. The Organic Act provides that every bill passed by the Legislature must be presented to the Governor who must sign it if he approves the legislation. The Governor has 10 days within which to return the measure with a veto message if he does not approve it. The Legislature may override a veto by the affirmative vote of two-thirds of its members. If the Governor does not approve the measure the second time, he must forward it to the President of the United States within ten days for final disposition. All laws enacted by the Legislature must be reported to the President and to the Congress of the United States, which reserves the power and authority to annul such laws at any time within 1 year from the date of their receipt.

In addition to the Governor and Secretary, the executive branch consists of 13 departments of government and 24 administrative agencies. Included in these departments are a Department of Education, a Department of Agriculture, and the Office of the Chief Commissioner.

The Chief Commissioner functions in the manner of a department head. His primary duty is to supervise the activities of the municipal commissioners, who are elected by the people, and to act as a liaison officer between them and the executive branch of the Government.

The municipal commissioners are active in agricultural affairs. Many activities are discussed with them and frequently requests for assistance, materials, or equipment from the Guam Department of Agriculture are made through the commissioners' offices.

### Education

Section 29(b) of the Organic Act states that the Governor shall provide an adequate public educational system for Guam, and to that end shall establish, maintain, and operate public schools in such places in Guam as may be necessary. Pursuant to this provision the Governor proposed legislation which was passed by the Legislature establishing a Board of

Education, curriculum and text requirements, teacher and teacher requirements, and pupil standards. It also permitted released-time instruction by Church-operated schools. The Board of Education is, under the law, "the governing and policy determining body" of the Department of Education. The public school system comprises 21 elementary schools, 1 junior high school, 1 high school, and 1 Territorial College, presently limited to a 2-year course. The adjusted appropriation for the Department of Education for the fiscal year 1957 totaled \$2,435,822.

There is some agriculture taught in the public high school under a new agricultural program which was started in 1956. A graduate of a university in the States conducts this program and devotes his full day to this effort. In the fall of 1956 there were 88 students enrolled in this course, which was divided into four classes--3 classes for beginners and 1 of 20 students for advanced training. The present program is planned for a 3-year elective course which will include both theoretical and practical phases.

Adult evening classes in agriculture are in the planning stage, according to school authorities. They also stated that agricultural courses will be coordinated with the Guam Department of Agriculture, which is considered a primary source of the information disseminated in the school's agricultural curriculum.

There has been some training conducted in the elementary schools in agricultural and homemaking projects. School authorities also reported 4 full-time teachers teaching homemaking projects 5 times a week in the high school with a well-organized program and good teachers.

#### Guam Department of Agriculture

"The primary objective of the Guam Department of Agriculture is the improved well-being of the people of Guam as the result of better food for all and better living for farm folks." This statement is included in a report that the Director of the Guam Department of Agriculture made to the Director of the Department of Budget and Management in submitting budget proposals for the fiscal year 1957. This report includes an outline of the policies and programs of the Department as follows:

1. The policies and programs of the Department emanate from the Director's Office, and cooperative relations with other governmental agencies clear through his office.
  - a. The Secretarial and Records Unit handles all office work for the Department.

- b. The Service and Custodial Unit sells seeds, fertilizers, etc.; provides tractor service for land clearing and plowing; propagates and distributes plants; maintains Department buildings, grounds, and equipment; and receives and safeguards materials and supplies.
2. The Extension Service surveys farm problems and disseminates to the farmers information on ways and means of better farming through demonstrations and visits at their farms. The Farmers Market is supervised by extension personnel. Extension personnel participate directly in demonstrational activities on the Department's farms. The 4-H Club and other agricultural training programs in the rural homes are sponsored by the Extension Service.
3. The Plant Industry Division conducts tests on new and improved crops and farming methods, and is directly responsible for the operations of the experimental and demonstration farm crop areas. The control of agricultural pests, except those of livestock, belongs to this Division, and it gives technical direction to plant quarantine enforcement. Forestry, soil and water improvement, and wildlife conservation are other functions of this Division. The Talofofo Demonstration Farm is used both as a testing ground for crops and to demonstrate to farmers by actual practice the principles of good farming.
4. The Animal Industry Division engages in the breeding of better poultry, hogs, cattle, and goats; and makes improved stock available to farmers. It directs control and quarantine activities against animal pests. The Division is responsible for testing better methods of livestock feeding and housing. The Yigo Demonstration Farm is used for tests and demonstrations of better livestock handling. The improvement of stock and regulation of fishing is a function of the Animal Industry Division.

The present Department of Agriculture was organized on July 1, 1955, by the Governor of Guam pursuant to the Organic Act. At that time Manuel A. Calvo was appointed director. A list of the personnel of this department provided for in the fiscal year 1957 follows:

I. Office of the Director

1. Director

A. Secretarial and records unit

1. Administrative secretary
2. Clerk, records

B. Service and custodial unit

1. Chief caretaker
2. Assistant to caretaker
3. Carpenter
4. Laborer
5. Chief mechanic
6. Mechanic

II. Extension Service

1. Farm advisor supervisor
2. Farm advisor
3. Farm advisor
4. Farm advisor
5. Farm advisor
6. Pest control operator

III. Plant Industry Division

1. Agriculturist
2. Entomologist
3. Gardener
4. Laborer
5. Laborer
6. Laborer
7. Laborer

IV. Animal Industry Division

1. Veterinarian
2. Animal husbandman
3. Fish and game warden
4. Assistant to husbandman
5. Laborer
6. Laborer
7. Laborer
8. Laborer

The average annual salary of the technically trained personnel in the Plant and Animal Industry Divisions is about \$8,000 per year. The average for trained personnel in the Extension Service is about one-half that rate. The explanation for this apparent discrepancy is that those in the former group, all with doctoral degrees, are from the States with training at stateside colleges or universities, while the Extension Service consists of Guamanians with no formal college training.

The three research specialists of the Government of Guam are contract employees and sign up for 2-year periods of service. At least two factors tend to limit the effectiveness of such employment.

1. The individual is not a United States Federal employee; hence, he does not accumulate U. S. retirement credit and does not have U. S. Federal employee compensation protection or Federal insurance. Many qualified people will not leave their stateside positions and cut loose from job security, even at a higher salary.
2. While a few individuals may choose, or be asked, to "sign on" for another tour of duty, most often the employee prefers to return to the States. There is thus no program continuity. Each new employee must learn the necessary background information for himself. This may take several months out of the short period of his contract.

The approved budget operations for the Guam Department of Agriculture for the fiscal year 1957 showed expenditures of \$147,240 for the fiscal year 1956 and an adjusted appropriation for the fiscal year 1957 of \$148,156.

Additional income is derived from the services to farmers in the sale of seeds, plants, and pesticides and in land-clearing operations. Income from these sources amounted to \$27,244 for the fiscal year 1956. This money is deposited in the treasury of Guam and is available to the Department of Agriculture as a revolving fund for further purchases, including seeds, pesticides, and additional land-clearing equipment.

Considering the short time the present Guam Government has been established and through it the local Department of Agriculture, commendation can be given to that department and its accomplishments to date. This progress has come about largely because officials and the people on Guam utilize their own resources and draw as much as possible upon outside experience. Their understanding of the agricultural needs and problems of the island and their apparent concerted effort to solve these problems are noteworthy. The Guam Department of Agriculture is handicapped in many ways and, of course, has its definite limitations. Nevertheless, it represents a start and provides a nucleus around which to build.

## AGRICULTURAL PROBLEMS OF GUAM

### Research

#### Personnel

The Guam Department of Agriculture already has the nucleus of a research agency for the planning and execution of a program dealing with the agricultural research problems of the island. At the time of this survey, technical research personnel, under the Director of the Department,

included three scientists, native to the United States, all with doctoral degrees from stateside universities or colleges and assigned respectively as agriculturist, veterinarian, and entomologist.

### Facilities

Facilities were being built in October 1956 to provide new offices, laboratories, and barns and other shelters, to implement an expanded agricultural program. The Guam Legislature has appropriated the sum of \$50,000 to build a new permanent warehouse and to start an office and laboratory building. This building program was expedited because the land and quarters of the Department were needed to expand school facilities which occupied adjacent areas.

### Program

The problems of the research workers at the time of the survey were those that are inherent generally in the States and Territories where a very small staff has to cope with the multiplicity of interests and problems in the broad field of agriculture. Modern research is a highly specialized calling with exacting requirements if a scientist is to explore thoroughly a given problem, keep up with the developments in his chosen field, and finally make a contribution to the solution of the problem on which he is working. The greatest task faced by the Guam agricultural scientist is that of devoting himself to his respective research field without dispersing his efforts over too great an area. A research program, particularly in a relatively small organization, requires a very close association of the work with extension activities. In fact, the research worker must devote a reasonable portion of his time to duties of an extension nature. The scientists associated with the Guam agricultural program, however, unfortunately are called on to carry more extension and other activities than would seem advisable. This results in seriously reducing their productivity in research. In addition, one scientist is called upon to contribute generously to the administration, management, and general housekeeping of the Guam Department of Agriculture. Although this appears to be a very expedient arrangement, research accomplishment is curtailed as a consequence.

The situation that prevails must be recognized in fairly evaluating the progress of the research program and making recommendations for improvement. The most likely way to give a better balance to the existing research program is through the bolstering of extension activities by concerted training of available extension personnel and by securing additional well-trained personnel for extension work. The training of such personnel, reasonably, should be equivalent to the training standards recognized as desirable for the scientists on the staff. Such a plan would release the scientists from a much greater proportion of extension work and should correspondingly increase their research production.

A survey of the scientists revealed that there was a range of between 65 to 30 percent of their time devoted to actual research activities while from 30 to 15 percent was devoted to extension matters. The balance of the time was devoted variously to other responsibilities of their positions. Further inquiry revealed that there was no time devoted to formal research planning with seminars, written project outlines, and a systematic project reporting of research results. A lack of trained help for record-keeping was reported. Staff meetings of research and extension personnel were scheduled irregularly, and it was stated that the value of such incidental meetings as had been held in the past did not appear to warrant continuation of such gatherings.

In reply to a specific question in regard to requests on the time of the scientists from Armed Forces personnel residing on Guam, it was stated that such requests were not excessive.

The scientists reported that the extension staff was dependable and helpful within their capacity and training in carrying research findings to the farmers and others on the island interested in agriculture. The consensus of the scientists was that the several commissioners of the municipalities constituted an important link in coordinating the work of the Guam Department of Agriculture with the individual farmers living in their respective municipalities.

Research facilities being constructed and soon to become available, the scientists considered, would serve adequately for the existing research program.

#### Demonstration Farms

A mixed reaction was noted from the scientists in regard to the value and research productiveness of the demonstration farms at Yigo, Talofofo, and Mangilao. For animal research the farm at Yigo was spoken of favorably. The farm at Talofofo, which is maintained primarily for plant research, is of only minor importance. It was considered that the Yigo Farm was of greater value as a research facility than for demonstration purposes. The Lalo Experimental Farm at Mangilao was in a state of neglect and of questionable value.

The survey group's opinion of the two active demonstration farms was that, with existing personnel and facilities, they left much to be desired for actual demonstration purposes. Apparently there is relatively little interest in these farms by the farmers. Adequate records of farmers' visits to these farms and other accomplishments were not available.

## Communications

The communication of research results to the farmers is hampered by a number of factors. The inability of many farmers to read English, and in some cases lack of comprehension of the printed, or even spoken, word, are factors that must be considered. Electric service is lacking at many farm homes, and, consequently, too much cannot be expected in disseminating research results by radio. It is estimated that there are only 2,500 radio sets on the entire island. For these an aggregate of 126 broadcast hours weekly are available.

There are two English and one English and Chamorro newspapers published on Guam that offer some potentialities to circulate research and other agricultural information. There is, however, limited circulation of these newspapers in the more rural parts of the island. Because there is also no mail delivery in the rural parts of Guam, adequate communication by this method is precluded. Of the 3,400 families on Guam producing all or part of their own food, it was estimated that 15 percent have radio sets and 20 percent receive newspapers. The Guam Department of Agriculture has prepared a number of mimeographed pamphlets which are supplied to satisfy some of the more frequent inquiries on subjects such as insects and diseases of garden crops, use of poultry manure, sanitation in pest control, the giant African snail, nematode damage, fish for farm ponds, and snakes on Guam.

## Needs

As all agricultural activities progress on Guam, plans should be made for an increase of the research personnel commensurate with expansion in other activities. It seems likely that well-trained personnel in the fields of agronomy and soils, agricultural economics and marketing, animal husbandry, home economics and nutrition, and horticulture will be needed, probably in that order. Unless it is possible to secure additional extension workers with modern and thorough training, the employment of competent research personnel with some extension experience may have to be considered. In this eventuality workers with some sound practical experience should be considered rather than scientists highly trained in a specific field.

With the completion of the building program, facilities will be adequate to take care of present research personnel. It will be necessary, however, to enlarge these facilities as expansion of personnel is accomplished. It will also be necessary to re-examine the role of the so-called demonstration farms, particularly if personnel is increased, to attain more efficient operation. This will require adequate funds; possibly retaining only one farm and making it more attractive would be advisable. If the

headquarters area is further developed to the degree that some of the smaller experiment stations are developed in the States, the value of any outlying farms may be questioned for the small total area of Guam. In such planning, cooperative research on the land of some of the more progressive farmers may accomplish better research demonstrations than the maintenance of the existing farms. Such arrangements would facilitate a study of different soil types, moisture conditions, altitude, rainfall, and other environmental effects as they vary on the different parts of the island.

### Extension

Because of the close relationship of extension and research, many comments in the foregoing section must be considered in connection with the extension situation on Guam.

### Personnel

The Guam Department of Agriculture provides for an Extension Service with, at the time of the survey, a staff of five Guamanians whose direct assignments concern extension. There is a supervisor of extension work and four farm advisors, two of whom are demonstration farm operators at Yigo and Talofofo, respectively. None of these men has a college degree. Each has had, however, varying experience in agricultural pursuits, teaching, and dealing with the public. The farm advisor who was leader of the 4-H Club work had been transferred recently to another department of the Guam Government.

### Facilities

The same facilities are available for research and for extension activities. These will be, when completed, adequate for the existing staff. Supplementary and additional facilities will be needed under an expanded program providing a more adequate Extension Service.

### Program

The program of extension in the Guam Department of Agriculture needs strengthening in both quantity and quality. No one on the staff is able to give adequate supervision of or training in extension work. The supervisor, however, could be given much valuable instruction in his work, even though he would not likely be interested in off-island training because of home responsibilities. The two farm advisors are not skilled in the group process or in extension organization, although they have rendered some fine service through the individual approach.

A feature of the USDA Experiment Station that was maintained on Guam from 1909-1932 was the Boys' and Girls' Club Work, particularly that carried on in 1919-1921 when, of 1,291 boys and girls, 1,145 completed the season's work and had produced \$19,209.08 worth of products. Within the last few years an attempt was made to re-establish youth work with a 4-H Leader to direct it. A relatively unproductive program has been conducted as part of extension activities.

A year or two ago, an employee of the Department of Education organized elementary and junior high school rural boys and girls in a program very much like 4-H Club work. Although this program was to include projects, no follow-up was made, and the effort failed. There are a small number of public school gardens which, in a way, add to the confusion of both youth and parents. Few seem to know about 4-H Club work for boys and girls and how it operates. Recently a vocational department was established at George Washington High School with teachers in home economics and agriculture. A vigorous program is being carried out.

At a meeting of representatives of the Guam Department of Education and the Guam Department of Agriculture with the survey group, the interests of both departments were reviewed as they related to the youth field. It is felt that a reasonable attitude was shown by the representatives of both departments. They expressed their concern for full agreement and cooperation. The 4-H Club work will stay in the Department of Agriculture.

The lot of the rural woman on Guam is one of hard work and few conveniences. Homes have few, if any, laborsaving devices. Much cooking is done out-of-doors. Sanitary toilets are not common. Drinking water is often impure and may be at some distance from the home. Pigs, dogs, and poultry may run under and even in the house. Cupboards are few. Household pests are common in most homes.

On the pleasanter side, the climate encourages vegetative growth, which results in much plant beauty around many houses. Village women may have electricity and even piped water from the Navy's big Fena reservoir. Small gardens are fairly common even for part-time farmers and village dwellers.

An opportunity for three or four thousand boys and girls to learn something of rural life and homemaking, as well as to earn some money of their own, could be effected by establishing a 4-H Club program in every municipality. Extension agents now do not do any youth work. They should be supplemented by agents who would spend about half-time with youth. Trained, local young women should be employed to work with women and girls. Agricultural agents should carry on youth and adult demonstrations in crops, livestock, and home improvement, as well as other educational work, in contrast to the personal service programs in effect.

The discussion of, and remarks concerning, the demonstration farms and communications, under the research heading, will apply, to even a greater degree, to Extension Service problems. The Yigo, Talofofo, and Mangilao Demonstration Farms were founded for a good purpose at the time. Now that these conditions have changed, less emphasis on demonstration farms and more demonstrations on private farms would be desirable.

Demonstrations on private farms in each municipality would result in greater extension of agricultural knowledge. Cooperative effort among farmers supported by technical advice and counsel would make great contributions. Helping farmers help themselves would yield more improvement than individual service to any farmer whenever he calls. This change had to be made in the States in order to serve more people. To the extent that adequate communications are not maintained with the farmers both research and extension services fail in accomplishing their missions.

### Needs

The most urgent present need for the Extension Service is a vigorous training program. It is apparent that the present staff lacks the know-how, guidance, and standards that are available in most of the States on the mainland. Additional personnel is also required, particularly to resuscitate the important 4-H Club activities for the young Guamanians. Of almost equal importance is an extension worker in home economics, nutrition, and homemaking. Concurrently with such an expansion, the need for increased attention to programing is apparent. After these objectives have been realized, added emphasis should be given to the field of extension communications. It is inevitable that expansion of postal, newspaper, radio, and television activities will occur. Extension work, to progress, must take full advantage of increased communication facilities.

### Land Policy

The acquisition and use of land on Guam is one of its most perplexing problems as it applies to the status of agriculture on the island. The large holdings with clear title are in the southern half of the island and are used as grazing areas or left idle. The northern half where title to the land is legally contested, leased in small plots or controlled by the military, is characterized by small farms of an acre or two. Since leased land is rented on a yearly basis, most farmers are reluctant to plant anything but annual crops. There is also a definite inclination to clear new land of jungle underbrush by use of government bulldozer service instead of continuing to work and utilize land cleared or partially cleared.

There is a definite need for the establishment by the Government of Guam of a land policy which will guide the development and utilization of this very limited resource. Such a policy must also concern itself with water, which is needed in increasing volume for domestic uses and should also become more readily available for agricultural purposes, including irrigation.

Both land and water resources are taken largely for granted by the Guamanian population for what they are today. There is urgent need for positive measures that will build up and conserve both so that present and future requirements may be met more adequately. Such a policy should also concern itself with the distribution of government-owned lands for agricultural and other purposes.

There is need for the establishment of some mechanism, perhaps a farmer committee, to make sure that government-owned land sold for agricultural purposes gets into the hands of individuals who are qualified for farming. Emphasis should be placed on development of the so-called family farm with the farm unit being of a size adequate to support the family. There also is room on Guam for an improved type of subsistence farming, and this can be achieved with proper planning and guidance. In addition, there is room for more part-time farming, or home food production, by those who are employed by the military or in private enterprises. The availability of land for all these types of farming needs to be included in any established land policy.

### Credit

For the time being, agricultural credit is not too much of a problem on Guam since the local Government has provided facilities for supplying credit for agricultural purposes under certain conditions through the Guam Finance and Development Administration.

The purposes of this agency, as set forth in Public Laws of Guam Nos. 14 and 31, are to augment the credit facilities available for the development of, to assist the development and advancement of, and to examine, investigate, and conduct research and experimental operations in agricultural, industrial, commercial, construction, housing, and related pursuits. Farmers may obtain loans for the purchase of land and for certain crop and livestock production operations at 5 percent interest, with the loan repayment rate varying for each loan. In some instances, credit needs are obvious, although many local people do not know what, if any, credit facilities exist. Some loans already made, raise doubts about the basis of the credit program and loan procedures.

Under conditions that have prevailed, Guamanian farmers are inclined to stay out of debt. Traditionally, the Guamanian has followed the policy that if he does not have the money he will go without until he can get the money he needs to buy what he wants.

If the agriculture of Guam is to be improved and further developed, wider use of credit will be needed. Before this will be possible, farmers will have to be educated to the important role of sound credit in agriculture and the part it can play to help the individual.

The established credit facilities may prove to be inadequate to meet future needs once farmers recognize the important role of credit and its place in their own individual operations. These facilities may have to be expanded or supplemented by existing facilities of the Federal Government, such as the Farmers Home Administration. However, no matter what the source of loans for agricultural purposes on Guam, it would be highly desirable that all agricultural loans be supervised by the lending agency, not only to insure repayment, but also to result in a sound farm operation.

#### Statistics

Statistics relating to agriculture on Guam are practically nonexistent, except for those obtained through the census or through some other special efforts.

In any agricultural planning and programing effort, agricultural statistics are vital for the light they shed on conditions and situations that prevail. At present there are hardly any such statistics available that can be employed as useful tools for informed action. Likewise, there is no system for the gathering and dissemination of statistics on market prices, available supplies, plantings, and production of crop and livestock products.

If the agricultural economy of Guam is to function effectively, it is necessary for the establishment of some agricultural statistical services which will gather and make available at least some of the more basic statistical information on a continuing basis.

#### Marketing

Most of the marketing of Guam's agricultural products is done in a primitive way. There is no grading or packaging. Little or no attention is paid to sizing and sorting. Most of the products are sold in bulk, packed in a jumble in whatever container may be handiest.

In general, the customer is expected to buy what the farmer offers. The products offered appear to be of general good quality although there are wide variations in degree of maturity.

The farmers have their own ideas of price. They generally feel that the market should pay the price they ask. The fact that the offered price should bear some relationship to prices of similar products from other sources, including the States, is neither understood nor recognized. Meeting this kind of competition is something new to the Guamanian farmer. He has yet to grasp its meaning in terms of his own producing and selling activities.

Most of the inadequacies of the existing marketing system are apparent in the Farmers Market at Agana. Here three times a week farmers gather to display their products in small stalls. There are 80 stalls, with a maximum of 50 and a minimum of 10 stalls occupied on market days during the survey. This is a retail market patronized mostly by housewives who desire to buy their produce as fresh as possible. The prices they pay are usually higher than those they would otherwise have to pay in the more progressive local food stores.

The farmers bring in a fairly good variety of produce, such as snap beans, eggplant, peppers, taro root, yams, wing beans, breadfruit, okra, bitter melon, bananas, papaya, and pineapple. The quantities brought in by each producer are small, usually equivalent of bushel and half-bushel lots or less.

The Farmers Market also offers an opportunity to sell eggs and poultry, but often these items are not available. Fresh meat is also sold by one vendor. This is sold from an animal slaughtered the same day. The meat is cut as the customer desires in a screened room located at the end of the market shed. Fresh water eels, shrimp, and salt water crabs are also offered for sale.

Those farmers who sell their products in the Farmers Market apparently do so regularly and rely on it as their principal outlet. Other farmers sell their products directly to the retail stores and these same farmers, as well as others who are in the larger farmer category, may also sell their products to the military bases for use in the various messes or for resale in the commissaries.

The armed services outlets on Guam provide the Guamanian farmer with a tremendous potential market for practically all the products that can be supplied, providing the quality is good and the price is reasonable. Unfortunately, however, only a small fraction of this particular demand is being met and that only sporadically.

There is great need for marketing education among Guamanian farmers to develop at least a basic understanding of some of the more important elements. Closer working relationships between the military food procurement officials and the Guamanian farmers through, perhaps, the local Department of Agriculture would do much to improve the situation and give each a better appreciation of the other's problems and needs. This would permit the establishment of a means of communication through which farmers could be kept informed of demands to be met and could plan their production accordingly, while the procurement officials could be kept fully advised of the availability of supplies in planning their purchases.

There is also great need for improvements in the marketing structure to facilitate assembling, handling, and selling of farm products. Middlemen are just coming into the picture, as indicated by the presence of two wholesalers who go out into the country to buy produce directly from farmers and in turn sell either to retail stores or to the military establishments. They also bring in produce from nearby islands to supplement the inadequate supplies on Guam.

The marketing structure could be improved materially through the organization and operation of cooperatives, but this cannot be accomplished overnight. An egg marketing cooperative has been functioning for a limited time with varying degrees of success; this organization is presently not very active but additional organizational efforts are being made. For the time being, there is great need for work with farmers in cooperative education so that out of this there may be organized the necessary healthy cooperative marketing organizations, as well as at least one cooperative purchasing organization.

For all the work in marketing, the services of a qualified marketing specialist is needed on a full-time basis. It seems necessary to start with an elementary and simplified type of organization and gradually build the structure as confidence is established among the participants and in the actual system itself.

### Soil and Water Conservation

There is little evidence on Guam that attention is being given to soil and water conservation. Farmers and technicians on the island acknowledge that losses are appreciable, but very little is being done to control erosion.

There are four areas on Guam that are designated as conservation sites. Although the Agricultural Law of Guam authorizes the local Department of Agriculture to protect and promote the agricultural resources of Guam by conservation work, it was reported that inadequate facilities have prevented any program of conservation in these conservation areas, or elsewhere on Guam.

The Guam Department of Agriculture has a copy of a detailed reconnaissance soil survey map of Guam. <sup>9/</sup> It is questionable if much reference is made to this survey for the purpose of recommendations for agricultural loans, fertilizer application, and crop adaptability.

The island is underdeveloped agriculturally. Comparatively large areas could be brought into a favorable use pattern.

Providing supplemental water for irrigation would facilitate leveling out the seasonal production of adapted crops. On the southern part of the island, water is available in many of the perennial streams. <sup>10/</sup>

To promote a soil and water conservation program Guam needs:

1. An evaluation of the recently completed soil survey to determine its adequacy for farm planning.
2. Technical assistance to help farmers and ranchers plan, reach decisions about, and apply complete conservation practices. These practices include: Proper land use; crop rotations; use of cover and green manure crops; water development and distribution; water disposal; range seeding; range management; planting of windbreaks; proper use of woodland.

Many of the farmers follow a system of "use and move" farming. A piece of land is cleared, used for truck crops for one or more years, then abandoned, and a new piece is cleared and used. The Guam Department of Agriculture is attempting to stabilize land use by making fertilizers available at nominal prices to encourage the farmers to maintain a favorable level of fertility. It is, however, inadvertently encouraging a system of opportunistic farming by providing land-clearing equipment at an exceedingly low rate with no conditions governing future use of the land.

Soil and water conservation on Guam should be recognized as an important part of any program to develop the island's agriculture. Technical aid from off-island sources, working in conjunction with the Guam Department of Agriculture, is suggested as the means of improving this phase of Guam's agriculture. A modest approach, stressing educational phases to develop an awareness in the Guamanian farmer of the part soil and water conservation plays in good agricultural practices, is desirable.

<sup>9/</sup> See Appendix B.

<sup>10/</sup> See Appendix C.

Demonstrations showing good conservation practices are needed. More than that, employees of the Guam Department of Agriculture need to be trained to a point of technical leadership to make good soil management practices common over the island. Such practices as are beyond the ability of the individual farmer can be approached through group effort. Both individual and group approach are indicated in this and other areas of agricultural improvement on Guam. Conservation of land and water must be closely tied to improved cultural and other management practices, use of good seed, and efficient marketing.

In time there will be a great pressure on both the soil and water resources of Guam. The land area available for civilian use and for agricultural production has been reduced greatly by the amount of land taken over for military purposes. Water requirements for military and civilian uses on Guam are exceptionally heavy, considering the size of the island. These requirements are increasing and the underground and surface sources of fresh water are definitely limited.

The conservation of soil and water resources so that they may be improved and further developed for more permanent use is of paramount importance on Guam. Both public and private effort will be needed in developing the necessary understanding of the conservation problem among all the people on the island and in bringing about the required corrective action. Individual farmers and other land owners have the basic responsibility in applying the measures needed to halt erosion and to conserve soil and water resources. But the problem of conservation on Guam extends beyond the boundary lines of any individual land owner's holdings.

Ultimately, it may be desirable to deal with the soil and water conservation problems on Guam through the kind of organized approach that is working successfully in the States and also in Puerto Rico. Such an approach could be made through the enactment of a Soil Conservation Districts Act by the Legislature of Guam. Such legislation, following the standard general pattern that has been set, would give to all farmers on Guam an opportunity for democratic self-help in dealing with the soil and water conservation problems of the land they own or operate. A law for Guam could conceivably provide for the organization of 2 soil conservation districts, 1 covering the northern part of the island and the other covering the southern portion. Each district would be a legal governmental subdivision with farmers in each district electing a specified number, perhaps 3 or 5, persons who would serve as supervisors and be responsible for administering the soil conservation program in the particular district. Overall administration and policy determination under a Soil Conservation Districts Act for Guam should be vested in the island's Department of Agriculture. That department would have the responsibility of cooperating closely with these district supervisors and assisting in providing the necessary technical assistance from its own staff or from other sources.

In connection with soil conservation activities on Guam, cost-sharing payments, such as those provided under the Agricultural Conservation Program, could be an important and effective means through which land owners and operators might be aided in doing essential conservation work needed in the public interest.

In the same way assistance available under the Watershed Protection and Flood Prevention Act (1954) might be helpful in facilitating the needed conservation of fresh water resources for agricultural uses on the island and in developing them further.

### Food and Nutrition

In the development of agriculture on Guam, producers need to keep in mind the requirements of the total market--military and civilian--so that the food needs of the local population will not be neglected. The bulk of the food used by the civilian population of Guam is imported, mostly from the States. These imports amount to a net of around \$6,000,000 per year. This high dependence on imported foodstuffs can be modified greatly by the Guamanian farmers themselves. In doing so they will bring about a vast improvement in diets. According to a recent study, the Guamanian diet is sorely deficient in fresh vegetables and fruits. Proteins could be increased in the diet through greater supplies of meats and fish from local sources.

Nutrition education is needed badly in both urban and rural areas. The services of at least three extension workers in home economics would make a real contribution to the health and well-being of the islanders and prove beneficial to the development of agriculture as well.

### Livestock and Poultry

With approximately two-thirds of the value of Guam's farm output derived from livestock and poultry products, production of these items has a definite place in the agriculture of the island.

Moreover, it is both desirable and possible to increase production of livestock and poultry. Not only is the volume being produced small in relation to the total potential market that exists on Guam, but there is also considerable opportunity for improvement in production practices.

The extent of the livestock industry now on Guam is indicated by recent slaughter figures. Local law requires Guam residents to obtain from their municipal commissioners permits to slaughter cattle, carabao, and hogs. During the 1955-56 fiscal year, permits were issued for the slaughter of 440 cattle, 86 carabao, and 2,934 hogs. While there are evidences that permits are obtained irregularly for the killing of roasting-size pigs, the figures indicating the slaughter of cattle and carabao are said to be reasonably correct.

Most of the meat slaughtered on Guam is consumed in the home and at village fiestas. Commercial slaughter and sale of the locally produced meat is very limited. During the 1955-56 fiscal year, the veterinarian of the Guam Department of Agriculture inspected and stamped approval on the carcasses of 174 cattle and 32 hogs, as required under the island's mandatory meat inspection law. Most of the slaughtering was done at approved sites in Inarajan and Mangilao. There are no commercially operated slaughterhouse or meat processing facilities on the island. Most of the inspected animals were slaughtered by an operator who sells meat at the Farmers Market and another operator who sells meat to local stores.

The Guam Department of Agriculture estimates that the farm value of locally produced meat consumed at home or sold during the 1955-56 fiscal year totaled \$982,740; an amount which obviously exceeded the value of livestock slaughtered under permits. At the same time, the commercial port of Guam had a net import of 3,854,362 pounds of frozen meat valued at \$1,421,240.

No dairy animals are kept on Guam for commercial milk production. A large part of the milk used on the island is either shipped-in canned milk or reconstituted milk produced in a plant operating under contract with the military establishments. The few dairy cows on Guam are kept largely for the production of milk for home consumption.

Most of the hogs sold on Guam are pigs which are, by custom, slaughtered for roasting. Most of these pigs weigh between 50 and 75 pounds. The slaughter of pigs at such light weights represents a considerable loss in potential meat supply. These pigs could readily be fed out to heavier weights with profit to the feeder if adequate commercial facilities were available to handle the animals and process the resulting meat supply.

The lack of such facilities greatly handicaps the production of all livestock on the island. In the prevailing situation animals that are slaughtered must be consumed almost immediately in order to prevent spoilage and waste. A small packinghouse with only a little equipment for processing and storing meat would broaden sales opportunities, particularly if the plant operated under the supervision of the local Department of Agriculture's veterinarian in accordance with Federal meat inspection requirements.

Such a facility would make it possible for local outlets to be supplied with various beef and pork products, such as hamburger, frankfurters, sausages, corned beef, cured ham, and other popular processed meat items which now must be imported. Livestock produced on the island could be utilized advantageously in the production of such meat products. This would help reduce the heavy dependence on imports that now prevails and at the same time be helpful to the expansion of livestock production. Producers of livestock would be in a position to sell their animals to better advantage and improve their marketing practices. There would be more incentive to produce higher quality meat animals and to sell them on a weight basis instead of at so much per head, as is the practice largely because of the lack of weighing facilities.

The market on Guam for the kind of meat products that could be produced from locally raised livestock and the potential for profitably increasing meat production seem to warrant the establishment with private capital of a properly equipped small packinghouse that could be expanded as future needs might require. If the livestock producers of the island could get together, they might find it advantageous to establish such a packinghouse on a cooperative basis.

If the local output of meat is to be increased, then it is also necessary to put into effect a livestock-improvement program, as well as a program to improve pastures and other sources of feed supply. This would help increase efficiency and lower production costs.

The Guam Department of Agriculture is engaged in cattle improvement work, but only on a limited basis. A Holstein bull, imported in April 1954, has sired several calves. Thirty-four cows were bred by this bull in 1955-56. The department also owns two Brown Swiss bulls and a number of other cows have been bred by them. In addition, the department in October 1956 imported from the States about a dozen bred heifers of the Holstein, Brown Swiss, and Jersey breeds. These animals will provide the basis for a demonstration dairy herd.

While the few bulls owned by the Guam Department of Agriculture are available for breeding cows that are owned by individual farmers, the effect of their use on the island's cattle industry as a whole is obviously very limited. This is readily apparent from the comparatively numerous nondescript bulls and the equally nondescript cows that may be seen tied to stakes in fields or in strips of pasture along the roadsides.

The use of good bulls on native cows, particularly with some selection of the cows, would go far to bring about needed improvement in the cattle population. The situation that exists on Guam holds possibilities for an artificial insemination program, which the Guam Department of Agriculture could operate on a service-fee basis with some addition to the bulls already on hand. Such a program, properly understood by the owners of cattle, could offer the best opportunity for the earliest widespread results from upbreeding of the native cattle population.

The Guam Department of Agriculture is also doing a limited amount of swine improvement work. The swine improvement project at the Yigo Demonstration Farm includes two purebred boars (Berkshire and Yorkshire) and seven selected native sows. Various crosses were made to develop one that would have the most desirable characteristics of prolificacy, hardiness, early maturity, and quality meat. During 1955-56 there were 76 pigs produced by the purebred Berkshire sows at the Mangilao Farm. A purebred Yorkshire boar and an unrelated purebred gilt were acquired to broaden the hog improvement program. Male and female offspring in excess of the needs of the department's swine projects are sold to farmers on the island for breeding purposes. In addition, the boars owned by the department are available to farmers for use in breeding their sows.

The swine improvement program of the Guam Department of Agriculture is having a beneficial impact on local hog production. Through the department's use of its boars on sows owned by individual farmers and its sale of stock for breeding purposes, a marked improvement has been brought about in the quality of hogs being raised. This represents a good start. However, in view of the importance of increased hog production on Guam, the swine improvement activity should be extended and the work with hog producers intensified. Some farmers who acquire selected stock from the department's swine herd should be encouraged to maintain a few breeding animals to produce offspring that could be sold to other farmers for breeding purposes. The effect of this would be to increase the sources from which desirable breeding stock would be available to more farmers and thus greatly extend the influence of the department's swine improvement program.

More intensive extension work is needed among hog producers in order to bring about changes in practices that will help make swine production more efficient and more profitable to them. Along with other educational techniques, demonstrations on individual farms should play an important role in focusing community attention on specific problems in hog production and ways of dealing with them most effectively.

The increasing number of hogs that are being concentrated in individual herds on Guam necessitates great vigilance and precautionary measures to safeguard against the ravages of disease and parasites. The danger of loss is heightened not only by wet climate but until recently by the extensive feeding of raw garbage. Until the end of 1956 virtually all of the garbage used was fed raw to the hogs.

The production of hogs on Guam has increased as a result of the availability of garbage for feeding purposes from the military establishments on the island. As long as this supply of garbage is available, hog production on Guam can be maintained and even increased further with improved collection and utilization of the feeding product, but the feeding of uncooked garbage has presented a most serious and constant disease menace.

A directive effective January 1, 1957, requires garbage from military installations to be cooked before it is used for feeding. This directive was issued and will be enforced by the military. While this move recognizes the danger of feeding raw garbage and imposes a military injunction against this practice, it also focuses attention on the need for the enactment of suitable legislation to prohibit the practice permanently. Enactment of such legislation by the Legislature of Guam with adequate provision for its island-wide enforcement would help provide valuable insurance for the future safety and well-being of the island's livestock industry.

Also essential is an educational program that stresses the importance of sanitation and other preventive measures which farmers need to employ to safeguard their livestock against diseases and parasites. The 1955 experience with hog cholera alone demonstrated the need for this educational work among farmers. Had such a program been in effect at that time, precautionary action, such as vaccination, could have been taken against the disease before it actually struck. The use of the new nonvirulent cholera vaccines should be investigated.

Production of poultry and eggs on a larger scale than prevails holds much promise in the economy of Guam. The basic need is to increase production efficiency and lower costs by enlarging the size of individual flocks in order to spread labor, depreciation, and other overhead or operating costs over a greater total output and thus minimize the cost per unit.

Important savings can also be made through improvements in flock care and management. Extension and research work adapted to the needs of poultrymen on the island can provide valuable guidance in helping these farmers improve their production efficiency. Where laying birds are kept in cages, there is considerable opportunity for mechanizing the feeding and other management operations. The possibilities of making additional savings through cooperative procurement of baby chicks, feeds, and other supplies also deserve to be thoroughly explored.

The cost of producing eggs and other poultry products on Guam is much higher than on the mainland largely because of the cost of transportation of feeds and other supplies that have to be shipped in from great distances. This is costly indeed, particularly when "healthy" resale margins are added on to already high shipping charges. As a result, the retail price of a 100-pound bag of laying mash ranges around \$7, almost twice the cost of the same feed on the mainland. Baby chicks are also expensive since most of them are flown in from the mainland. During 1955-56 about 44,000 sexed chicks were brought in at a delivered cost of about 60 cents per bird.

Although production costs are higher on Guam, selling prices for local poultry products obviously must bear some reasonable relationship to prices of these same items shipped in from mainland sources. If the local eggs, for example, are priced too high (considering freshness and other quality factors) in relation to the imported items, experience shows that the weight of consumer preference will shift to the eggs shipped in from the mainland or other sources. It is during such periods that poultry producers on Guam find themselves with a surplus of eggs on hand even though at best local production is far short of the island's consumption requirements. Such a situation merely emphasizes the importance of developing the poultry and egg industry on Guam to a point where it can be reasonably competitive in the local market. This can be accomplished by individual producers' increasing their volume to such an extent that per unit costs are minimized and improving their production efficiency in other ways.

There are 41 commercial poultrymen on Guam. Of the five largest producers, two are from the mainland. The total number of chickens on the island is estimated at 210,000. The commercial poultrymen use shipped-in mixed feeds while the small flock owners use mainly native sources of feed, such as coconuts, fruits, etc. Incidentally, some research work would appear desirable in order to develop any local economical sources of poultry and livestock feeds that could be used to reduce the heavy dependence on imported feedstuffs.

Most of the birds kept in the larger flocks are primarily for egg production. During the 1955-56 fiscal year, the value of eggs consumed on farms or sold is estimated to have totaled \$1,301,385. Broiler production is just getting under way on a very limited basis, perhaps not over 10,000 per year. These are raised by farmers who are also commercial egg producers. The cost of producing broilers on Guam is high because of the greater cost of baby chicks and feed than on the mainland. In view of the circumstances that now prevail, the production of broilers on the island is not likely to develop into an extensive commercial enterprise that will be able to compete with frozen broilers shipped in from mainland producing areas.

The Guam Department of Agriculture is carrying on a program to improve poultry on the island. The aim is to have not more than two breeds dominant in the poultry industry instead of several as at present. These two breeds are the New Hampshire Reds for meat and eggs and Leghorns for egg production. The department maintains two moderate-size laying flocks of these birds. They are kept primarily for breeding purposes and are an important source of good quality chicks. In 1955-56 the department produced 33,000 baby chicks which were sold to local farmers at relatively low cost.

Effective work is being done by the department in getting commercial poultrymen to protect their flocks from diseases and parasites and to follow other good management practices, such as timely culling. More poultrymen need to be reached by this work since there are a number of commercial producers and many more small flock owners who could make effective use of this valuable assistance.

The kind of intensified and broadened program that needs to be carried out to improve and further develop the livestock and poultry industries on Guam will add greatly to the burden of work already being done by the very limited staff of the local Department of Agriculture. The staff is inadequate for the size and scope of the job that needs to be undertaken. In view of this, it is apparent that the services of a qualified livestock and poultry specialist with broad training in this field of work will need to be employed to assist in this particular phase of the animal industry program and to cooperate with the farm advisors and other members of the department's staff.

### Crops

Vegetable production and marketing can be expanded greatly on Guam to supply both the native population and large military forces with fresh produce. Likewise, any expansion of the livestock industry would emphasize the need for and importance of greater local production of animal feeds and forages. The high costs of concentrates shipped to Guam from the States for poultry points specifically to the desirability of the wider use of island-produced feeds.

Recent estimates of land available for crop production show that of 40,000 acres of unused land on Guam, 20,000 acres are potentially productive for agriculture, and 10,000 acres for forestry. In the agricultural areas of Guam these same estimates indicate 50,000 acres, with 30,000 acres of this arable land and land under tree crops, and 20,000 acres permanent meadows and pastures. Of the total arable land there are only 3,000 acres in temporary meadows, 10,000 acres temporary fallow, and 3,000 acres in market and kitchen gardens. There are 20,000 acres of the agricultural area in permanent pastures and meadows of which only one-twentieth is improved. There is estimated to be 24,000 acres of forested land on Guam, of which 17,000 acres are used for grazing.

With this land potential it would appear that, through improved methods of management, the production of feeds and forages could be expanded manyfold. Such developments, however, must take into account all of the factors involved, such as the availability of land to progressive farmers who could make it more productive, capital to carry on good land management with suitable mechanical equipment, and, finally,

reasonable assurance of a market for the crops produced. The establishment of permanent pastures, stability of row crop production, sustained intensity of truck crops production--all require good land with protected ownership or operation on a longtime lease basis and an adequate fertilizer program.

Capital and credit, to make agricultural enterprises profitable, are next in importance to actually having good land available for use. Modern management requires funds to give the enterprise an optimum size for profit. To this end a re-examination of the assets of the farmer and the credit available must be considered in expanding the production of agricultural crops on Guam.

The management of such land for pasture, row crops, or truck crops becomes of increasing importance as the supply is more limited. Roving farming under any circumstances is not consistent with the development of a sound agricultural enterprise. In good soil management for crop production, research and extension activities are keystones to success. Land preparation, fertilizer practices, moisture relationships, soil conservation, and crop rotation become of increasing importance as land becomes more valuable and competition at the market place increases.

The profitable marketing of agricultural crops is the final link in the chain that will mean the success of the enterprise. Risk is inherent, but careful planning by able farmers, coupled with good management and modern harvest methods, will go far in assuring success.

As pointed out earlier there are no facilities available on Guam whereby statistics are gathered concerning agriculture. The staff of the Guam Department of Agriculture is frequently called upon for such information both from national and international sources, but this small staff is not adequate to engage in the necessary survey work. As far as crops are concerned, the 1950 U. S. Census is the only source from which some knowledge may be gained of the status of agricultural production on Guam.

For many years before World War II copra from the coconut palm was the leading cash crop of the island. The production of copra, however, declined; between 1936 and 1940 exports decreased from 2,600 to 1,660 tons, and in 1941 less than 100 tons were shipped out. There has been virtually no export trade in this commodity since the war. The trees are now in a low nutritional state, and it is believed that it is too late for even good cultural practices to bring them back into profitable production. Producers would have to start with young vigorous trees, using modern methods of production. Some believe that there is more promise of profit in the production and sale on Guam of bananas, papaya, avocado, citrus fruits, green onions, eggplant, pepper, tomato, lettuce, and other truck crops than there is in the laborious production and marketing of copra.

In the next decade it would appear that the most promising crops for Guam would be those which can be produced for sale and for home use. The military establishments have expressed a keen interest in procuring local truck crops and fruits, and the expansion of livestock points to a growing demand for feed and forage for animals and poultry. It must be borne in mind, however, that modern methods of production and marketing are mandatory to the success of these enterprises. This again brings up the basic requirement of training through an adequate Extension Service and research studies in modern production and marketing methods under the existing conditions on Guam, including studies to determine the feasibility of re-entering the export market.

### Pests and Quarantine

Guam has many insects and other pests, some of which have been on the island for many years and some of which are of recent introduction. During the period in which the USDA survey group was on Guam, the subject of pests clearly was an item of much interest to many people. Some felt that the major agricultural problem was pests.

While it is true there are insects and other pests on Guam, there are no more, nor are their depredations any greater, than in many other agricultural areas in the United States.

The main pests and dates they were first reported on Guam are:

(A)	The African snail ( <u>Achatina fulica</u> )	1946
(B)	Corn earworm ( <u>Heliothis armigera</u> )	1911
(C)	Corn borer ( <u>Pyrausta nubilalis</u> )	1911
(D)	Fruit flies:	
	Melon fly ( <u>Dacus cucurbitae</u> )	1936
	Oriental fruit fly ( <u>Dacus dorsalis</u> )	1948
(E)	Philippine lady beetle ( <u>Epilachna lemniscata</u> )	1948
(F)	Banana root borer ( <u>Cosmopolites sordidus</u> )	1936
(G)	Chinese Rose beetle ( <u>Adoretus sinicus</u> )	1949

Through the cooperative efforts of the Trust Territory and the Pacific Science Board of the National Research Council, Guam is receiving a proportionate supply of the carnivorous snail, Gonaxis kibweziensis, as populations of this predator of the African snail are built up on an isolated island in the Trust Territory.

Both the corn earworm and corn borer were found on Guam before they were discovered in the United States. Several insects have been liberated on Guam to control the borer; these include Lydella sp., a tachnid fly, which parasitizes the larva of the borer. It was introduced successfully in 1931. Additional shipments of Lydella sp. were received on Guam in 1952 and 1954.

To control the melon fly and the Oriental fruit fly biologically seven species of a braconid parasite, Opius sp., and a chalcid parasite, Synthomosphyrum indicum, were released between 1950 and 1953. Successful establishment of these insects has not been verified.

An apparently successful introduction of a parasite, Pleurotropis epilachnae, to control the Philippine lady beetle was made in 1954.

According to the Report of the Pacific Science Board, the histerid beetle, Plaesius javanus, which was introduced successfully into Fiji in 1914 to control the banana root borer, also was introduced into Guam in 1947. The histerid multiplies slowly, but a report from Guam in 1949 indicated that it had become established.

The Chinese rose beetle is a serious defoliator of plants. To control this pest, consignments of a scoliid wasp, Campsomeris marginella modesta Sm., were sent to Guam in 1951.

There is much concern on Guam that two pests of coconut now found in the Trust Territory might enter Guam via surface vessels plying between the Trust Territory and Guam. These pests are the Rhinoceros beetle (Oryctes rhinoceros Lin.) and the Mariana coconut beetle (Brontispa mariana Spaeth). The former probably was introduced into the Palau Islands during World War II; the latter was discovered on Saipan in 1931. The Trust Territory has instituted strong control measures for the eradication of both these insects and is continuing a program of biological control with the introduction of new predators. The Trust Territory, despite the presence of these pests, is relying on its production of copra for its economic life. Guam at present is not producing copra that can be considered as being on a commercial basis in terms of quantity, quality, or price.

Since the Chinese rose beetle, the melon fly, the Oriental fruit fly, and the Philippine lady beetle are not known to be distributed in the Trust Territory, the greater economic danger lies in the accidental transmission of these insects from Guam to the Trust Territory.

The above discussion summarizes only the attempts made to control biologically the principal pests of Guam. This, of course, is the classic method, and results cannot be expected overnight. Since considerable emphasis has been placed on the importance of this pest problem, it would be appropriate to enumerate other measures which can and should be considered in a future program for the control of these pests:

1. Strong educational program to overcome the concern which surrounds the subject of agricultural pests of Guam.
2. Encouragement of good cultural practices about the farm.
3. Promotion of the use of standard insecticides and establishment of definite procedures and plans for their application.
4. Closer working relationship between the farmer and the Extension Service.

One of the major problems put forward by the Government of Guam officials has been that of plant quarantine. It is their strong belief that to have a complete agricultural program it is necessary that enforcement of the Plant Quarantine Act of 1912 and succeeding legislation be carried out by Federal action or that this authority be delegated to the Government of Guam.

Some of the factors to be considered in respect to quarantine enforcement are:

1. No ships of foreign registry may call at Guam because of security reasons, Guam being a keystone of American defense in the Pacific. This prohibition, which apparently will be in effect for some time, eliminates one major mode of entry for foreign plant pests or diseases.
2. Statistics obtainable from the commercial port of Guam indicate that at least 90 percent of the fresh fruit and vegetables are imported from the United States. Very little produce of this type enters from the Philippines or Japan.
3. The Government of Guam has a trained Port Security Force that enforces local customs, public health, and plant quarantine regulations to a limited degree.

Insofar as the possible introduction of livestock diseases through the importation of cattle and poultry is concerned, at present there is no importation of cattle from foreign sources. Only a few fighting cocks from the Philippines and one or two showbirds from Japan are imported each year.

### RECOMMENDATIONS

The Guam Survey Group recommends that:

1. Federal agricultural services be extended to Guam. In planning the extension of these services due regard should be given to: The status of the people on the island, their economy, and stage of rural development; the strategic importance of the island to the United States; and the Federal funds presently appropriated to the States and to other Territories of the United States for the furtherance of their agricultural pursuits.
2. Legislation be enacted to authorize the Secretary of Agriculture: (a) To establish and maintain a joint agricultural program on Guam that will promote the welfare of that island; (b) To utilize any authority available to him to such extent as he may determine necessary to meet the agricultural program needs of Guam, without the necessity of amending existing laws specifically extending them to this island; and (c) In developing and carrying out such agricultural program to utilize the agencies, facilities, employees and other resources of the Department of Agriculture as he may determine, and to cooperate with the Government of Guam and other public and private organizations and individuals on Guam and elsewhere.
3. The Agricultural Research Service, or such other agency as the Secretary may designate, be given the primary responsibility insofar as the Department is concerned, for the planning, development, and general administration of the Agricultural Program for Guam.
4. The Secretary appoint a standing advisory committee with one representative each from the Agricultural Research Service, Federal Extension Service, Agricultural Marketing Service, Soil Conservation Service, and Farmers Home Administration. The duties of this committee should be: To advise in the planning of the Program, to enlist the support of the respective agencies of committee members in the Program's development and implementation; and to review and evaluate the progress of the Program.

5. Provision be made for any other agencies of the Department to participate with the advisory committee whenever necessary in dealing with specific problems with which they may be concerned directly.
6. The working relationships between the U. S. Department of Agriculture and the Guam Department of Agriculture be covered in a suitable Memorandum of Understanding. The objective should be to strengthen and to improve the Guam Department of Agriculture so that it may have eventually the kind of organization and staff competence required to provide the services in agriculture, home economics, and rural life needed by the people on this island.
7. The U. S. Department of Agriculture's principal contribution initially be in the form of supplying to the Guam Department of Agriculture technical assistance for effective organization and appropriate training of its staff. Such technical assistance is needed in the fields of agronomy, soil and water conservation, livestock and poultry, horticulture, marketing, research and extension work in agriculture, home economics, 4-H Club work, and other rural development. The specialists supplied by USDA should in effect constitute a technical assistance team that would be associated with the Guam Department of Agriculture until such time as the objectives are accomplished.

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5. Useful Plants of Guam. William E. Safford. Contributions from the United States National Herbarium, Smithsonian Institution, U. S. National Museum, April 8, 1905.
6. Guam, U. S. A., Birth of a Territory. Russell L. Stevens, 1956.
7. Report of a Special Subcommittee on Territorial and Insular Affairs of the Committee on Interior and Insular Affairs, House of Representatives, Eighty-third Congress, Second Session, Committee Print No. 3, Eighty-fourth Congress, First Session, Washington, D. C., 1955.

Appendix A: Lists of Statutes

The following List 1 and List 2, furnished by the Office of the General Counsel, U. S. Department of Agriculture, include statutes as of August 1956, pertinent to the work of the survey group, but do not include all statutes administered by the U. S. Department of Agriculture:

List 1

Statutes Administered by Department of Agriculture  
NOT Applicable to Guam. (See List 2, which follows,  
for Statutes Applicable to Guam.)

The Poultry Improvement Act, as amended (7 U.S.C., sec. 429), authorizing the Secretary of Agriculture to cooperate with authorities in the States and in Alaska, Hawaii, and Puerto Rico in the administration of regulations for the improvement of poultry.

The Bankhead-Jones Farm Tenant Act of 1937, as amended (7 U.S.C., secs. 1000-1032), authorizing loans to farmers, mortgage insurance, and a program of land conservation, now applicable to Alaska, Hawaii, Puerto Rico, and the Virgin Islands.

Section 515, of title 16, National Forests (16 U.S.C., sec. 515), relating to the authority of the National Forest Reservation Commission to acquire forest lands.

Sections 564, 565, and 569, of title 16 (16 U.S.C., secs. 564, 565, 569), relating to the protection of forests from fires and to the acquisition of land for forests.

The Soil Conservation and Domestic Allotment Act, as amended (16 U.S.C., secs. 590a-590q-1), providing for the control and prevention of soil erosion and the preservation of soil fertility, now applicable to Alaska, Hawaii, Puerto Rico, and the Virgin Islands.

The Agricultural Extension Act (7 U.S.C., secs. 341-348), establishing and maintaining agricultural extension services in connection with the land-grant colleges, now applicable to Alaska, Hawaii, and Puerto Rico.

The Agricultural Experiment Station Act (7 U.S.C., secs. 361a-361i), authorizing the establishment of agricultural experiment stations to be operated in conjunction with the agricultural and mechanical colleges, now applicable to Alaska, Hawaii, and Puerto Rico.

The Agricultural Research Act, as amended (7 U.S.C., secs. 427-427j), authorizing research in basic problems of agriculture to be performed in large part by the agricultural experiment stations.

The Agricultural Adjustment Act of 1933, as amended (7 U.S.C., secs. 601-659), authorizing marketing agreements and an order program with respect to certain agricultural commodities.

Anti-Hog-Cholera Serum and Hog-Cholera Virus (7 U.S.C., secs. 851-855), authorizing marketing agreements between the Secretary of Agriculture and the manufacturers of anti-hog-cholera serum and hog-cholera virus.

The Sugar Act of 1948 (7 U.S.C., secs. 1100-1160), providing quotas for the production and importation of sugar and authorizing conditional payments to sugar producers.

The Agricultural Adjustment Act of 1938, as amended (7 U.S.C., secs. 1281-1407), authorizing the establishment of acreage allotments and marketing quotas with respect to six basic agricultural commodities. Price Support of Agricultural Commodities (7 U.S.C., secs. 1430, 1432, 1441-1449), authorizing price support for certain agricultural commodities.

The Federal Crop Insurance Act, as amended (7 U.S.C., secs. 1501-1519), providing for a system of Federal crop insurance for farmers.

Soil Bank Act, Title I, of Agricultural Act of 1956 (Public Law 540 - 84th Cong.), providing for a program of soil, water, forest and wildlife conservation.

Title IV of Agricultural Act of 1956 (Public Law 540 - 84th Cong.), providing for assistance to States for tree planting and reforestation.

## List 2

Statutes Administered by Department of Agriculture  
Applicable to Guam. (See List 1 for Statutes NOT  
Applicable to Guam.)

The Commodity Exchange Act, as amended (7 U.S.C., secs. 1-17a), empowering the Secretary of Agriculture to regulate commodity changes, to designate certain boards of trade as "contracts markets," and to register commission agents and brokers who deal in futures.

The United States Cotton Standards Act, as amended (7 U.S.C., secs. 51-65), establishing quality standards for cotton and requiring the use of such standards in certain transactions.

The United States Grain Standards Act, as amended (7 U.S.C., secs. 71-87), authorizing the Secretary of Agriculture to establish standards for the quality and condition of grain in interstate commerce.

The Naval Stores Act (7 U.S.C., secs. 91-99), providing for the establishment of official standards for turpentine and resin.

The Federal Insecticide, Fungicide, and Rodenticide Act of 1947 (7 U.S.C., secs. 135-135k), regulating the marketing of economic poisons and devices and providing for their registration.

Insect Pests (7 U.S.C., secs. 141-147a), forbidding the transportation in commerce of certain insects, except for scientific purposes.

The Insect Control Act, as amended (7 U.S.C., secs. 148-149), authorizing cooperation between the Secretary of Agriculture and States, organizations, and individuals with respect to the control of incipient or emergency outbreaks of insect pests and plant diseases.

Golden Nematode (7 U.S.C., secs. 150-150g), relating to the protection of potato and tomato production from the pest known as the golden nematode.

Nursery Stock and Other Plants and Plant Products (7 U.S.C., secs. 151-167), regulating the importation and shipment in interstate commerce of nursery stock, plants, and plant products.

The Packers and Stockyards Act, as amended (7 U.S.C., secs. 181-229), regulating the business practices of packers in interstate commerce, of stockyard owners and operators, and of live poultry dealers and handlers.

The United States Warehouse Act, as amended (7 U.S.C., secs. 241-273), providing for the licensing of warehouses in which agricultural commodities are stored for shipment in interstate commerce.

Honeybees (7 U.S.C., secs. 281-283), preventing the introduction and spread of diseases dangerous to honeybees and prohibiting the importation of adult honeybees.

Associations of Producers of Agricultural Products (7 U.S.C., secs. 291-292), authorizing persons engaged in the production of agricultural products to act together in associations in processing, handling, and marketing such products.

The Produce Agency Act (7 U.S.C., secs. 491-497), making it a criminal offense to destroy or dump perishable farm products without reasonable cause, or to make false reports concerning the quality or quantity of such products.

The Perishable Agricultural Commodities Act, as amended (7 U.S.C., secs. 499a-499r), requiring the licensing of all persons who act as commission merchants, brokers, or dealers in fresh fruits and vegetables in interstate and foreign commerce.

The Tobacco Inspection Act (7 U.S.C., secs. 511-511q), regulating transactions in interstate commerce involving tobacco.

The Rural Electrification Act, as amended (7 U.S.C., secs. 901-924), providing for loans to improve and expand electrification, plumbing, and telephone facilities in rural areas.

The Federal Seed Act, as amended (7 U.S.C., secs. 1551-1610), regulating foreign commerce in specified agricultural seeds.

Distribution and Marketing of Agricultural Products (7 U.S.C., secs. 1621-1629), authorizing research and services in connection with the marketing of agricultural products.

The Disaster Loan Act (12 U.S.C., sec. 11448a-2), authorizing the Secretary of Agriculture to make loans to farmers for agricultural purposes in any area which has suffered a production disaster.

National Forests (16 U.S.C., secs. 471-527), authorizing the President to set aside lands as national forests, which except for section 515 applies generally throughout the jurisdiction of the United States.

Forests; Forest Service (16 U.S.C., secs. 551-583i), relating to the protection and conservation of the national forests, which, except for sections 564, 565, 569, and 681a applies generally throughout the jurisdiction of the United States.

Water Conservation (16 U.S.C., secs. 590r-590z-11), relating to wastage of water and to inadequate utilization of water resources on farm, grazing, and forest lands.

Protection of Timber, and Depredations (16 U.S.C., secs. 591-616), relating to the protection and preservation of forest resources from insect pests and diseases, and concerning the cutting of timber on public lands.

The Meat Inspection Acts, as amended (21 U.S.C., secs. 71-98), requiring the examination of slaughterhouses and the inspection of meat prepared for interstate or foreign commerce.

The Cattle Import and Quarantine Act, as amended (21 U.S.C., secs. 101-105), empowering the Secretary of Agriculture to quarantine imported animals.

The Animal Contagious Diseases Act, as amended (21 U.S.C., secs. 111-131), authorizing the Secretary of Agriculture to take such action as he deems necessary to prevent diseases among animals.

Viruses, Serums, Toxins, Antitoxins, and Analagous Products (21 U.S.C., secs. 151-158), regulating viruses and serums which are manufactured for use in the treatment of various domestic animals.

Flood Control, as amended (33 U.S.C., secs. 701-709), relating to flood control projects upon the navigable waters of the United States.

Sec. 416 of Agricultural Act of 1949, as amended (7 U.S.C., 1431), authorizing CCC to donate food commodities to public and private agencies for the assistance of needy persons in and outside the United States.

The National School Lunch Act of 1946, as amended (42 U.S.C., secs. 1751-1760), providing grants-in-aid to the States and to Alaska, Hawaii, Puerto Rico, Virgin Islands, and Guam for the establishment and maintenance of nonprofit school lunch programs.

Appendix B: Major Soil Units of Guam <sup>1/</sup>

Unit 1. Guam Clay

General Features. This soil type consists of reddish, granular, friable clay which thickly mantles the large, purer portion of the Mariana limestone formation. In total area, it is the most extensive soil unit on Guam. But, because of its shallowness and low moisture-holding capacity, it is not very important agriculturally.

Unit 2. Toto Clay

General Features. This unit consists of deep, pale olive to pale yellow, reddish-mottled, firm and plastic clay on the argillaceous (Agana) member of the Mariana limestone. It is mapped only on a few flat, micro-undulating ridge tops southeast of Agana, among areas of Saipan-Yona-Chacha clays. The soil is subject to unusual shrinkage and expansion, having large cracks in dry weather and being water-logged in wet weather. The pH reaction is acid near the surface and generally alkaline at depths more than three or four feet below the surface.

Unit 3. Chacha-Saipan Clays

General Statement. This unit contains two kinds of soil so intimately associated that time was not available to map them separately. In many places the gradation of individual characteristics between the two soils was such that their separation on the map would have to be purely arbitrary.

General Features. This unit consists of a yellowish-brown, firm, plastic Chacha clay and the red, firm, plastic Saipan clay, both moderately deep to very deep on the argillaceous (Agana) members of the Mariana limestone formation. The unit is on undulating or youthful karst topography. Convex surfaces are well-drained; concave surfaces are moderately well-drained and are subject to temporary flooding. The dark surface horizons are about neutral in reaction and the subsoils are acid, except near limestone.

Unit 4. Saipan-Yona-Chacha Clays

General Statement. This unit is an association of three kinds of soil on rolling to moderately hilly slopes. Except for stronger prevailing surface gradients, two of the soils (Saipan clay and Chacha clay) are essentially as described in Unit 3. The other soil of this association, Yona clay, is found on many of the convex surfaces, and some of its identifying characteristics are mentioned.

<sup>1/</sup> Described in a detailed reconnaissance soil survey of Guam. From an unpublished report by C. H. Stensland and J. E. Passeur, U. S. Geological Survey.

General Features. This unit consists of reddish Saipan clay and the yellowish or strong-brown Chacha clay (profile described under Unit 3) mapped on rolling or more strongly sloping topography than in Unit 3. These soils are interspersed with shallow, brownish Yona clay on many of the narrow, convex ridge tops. Relative relief of the soils may be regarded as intermediate between the undulating topography of Unit 3 and the deeply dissected or hilly to steep terrain of Unit 5.

#### Unit 5. Yona-Chacha Clays

General Statement. The two major soils of this unit are associated in the areas of strongest slopes and greatest local relief found in the argillaceous limestone on Guam.

General Features. This unit consists of shallow, brownish, granular Yona clay and yellowish (strong-brown), firm, plastic, Chacha clay in deeply dissected topography of the argillaceous limestone. Chacha clay, described in detail under Unit 3, is found on some of the ridge tops, toe-slopes, and in those ravine and sink bottoms which have only small, intermittent surface drainage and relatively little accumulation of recent sediments. Yona clay, described here, is found on most of the narrow ridge tops and adjacent steep slopes.

#### Unit 6. Atate-Agat Clays, rolling soils in the weathered volcanic rocks of Guam

General Statement. Three major soils and one land type are mapped on the weathered volcanic rocks of Guam. These four taxonomic units are grouped in various ways into three mapping units, based somewhat upon the geographic association and topographic relationship of the soils. Names of the soils in each map unit are listed in the order of dominance or extent of individual soils within the unit.

General Features. This unit consists of two soils, a Latosol, and a truncated-Latosol, with similar "C" horizons. Atate clay, the Latosol, is red, granular, acid clay associated with small bench-like mesitas in the more gently sloping terrain on all kinds of volcanic rock. Adjacent rolling to hilly slopes mostly truncated by erosion are generally of Agat clay. Exposed "C" horizons of the two soils are similar, consisting of friable to plastic, varicolored, red-stained or mottled volcanic rock weathered to clay to depths ranging from a few feet to about 100 feet and averaging about 50 feet.

#### Unit 7. Agat-Asan-Atate Clays, hilly

General Statement. The three taxonomic soils listed in the name of this map unit are developed equably on all three of the major volcanic rock formations which comprise much of the southern half of Guam. Because of the great depth of weathering in these rocks, the kind of original rock formation has little influence upon the kind of soil developed on it.

There is evidence that the red granular material of the Atate clay "A-B" horizons may have been formed as long ago as Plio-Pleistocene time. Subsequent geologic truncation, erosion, and dissection of a large part of this ancient soil mass have played a large part in the creation of the present soil landscape. The ways in which the taxonomic soil units are associated in the varied soil map units (Units 6, 7, and 8) more or less reflect the effects of relief and topography upon the processes of soil formation.

General Features. This unit is an association of soils in hilly terrain. Relief is intermediate between that of Unit 6 (rolling) and of Unit 8 (very hilly). The reddish stained and mottled clay subsoils of Atate clay and of Agat clay average 50 feet deep or more. The grayish, pale yellow to pale olive subsoil of Asan clay may not be quite so deep and it has only minor amounts of intensities of red staining, mostly in the upper part. External drainage is rapid; internal drainage is slow; depressions in the "C" horizon are permanently wet. pH reaction of dry or only occasionally wet soil is acid; in a zone of continuous saturation, it is alkaline.

#### Unit 8. Agat, Asan, and Rock Outcrop, steep

General Features. This unit is an association of soils in very hilly to mountainous terrain. It consists predominantly of the truncated-Latosols Agat clay and Asan clay, with some dark grayish brown Lithosols and scattered small areas of rock outcrop. In some places the reddish-stained and mottled Agat clay is predominant, while in other places the grayish, pale yellow to pale olive Asan clay is more prevalent. External drainage is very rapid; internal drainage is slow; depressions in the "C" horizons are permanently wet. pH reaction is generally acid above the water table and alkaline in the water table, except in areas of Lithosols or bedrock outcrop where the reaction may be only shallowly acid or entirely alkaline.

#### Unit 9. Pago Clay

General Features. This unit is a deep, moderately well-drained, noncalcareous Alluvial clay developed in sediments derived chiefly from volcanic rocks, but which are laid down and permeated by waters containing solutions from limestone. The subsoil is varicolored, firm, plastic clay, predominantly reddish or yellowish brown, with gray mottling in the lower part. The soil is subject to occasional flooding, but the water table is 1 to 7 meters below the surface during a considerable part of the year.

#### Unit 10. Merizo Clay

General Features. This unit is a wet poorly drained equivalent of Pago clay (Unit 9), having the water table on the surface for brief periods but most of the time at shallow to moderate depth below the surface. Poor drainage mottling is at depths shallower than 30 inches and generally is at 10 to 24 inches. The clay is moderately plastic and moderately firm, except in local, depressed areas where organic content is high and the clay is more nearly soft. The pH reaction is neutral to alkaline.

#### Unit 11. Muck

General Features. This unit consists of poorly drained clay containing 20 to 50 percent organic matter, referred to as muck. This muck is a mixture of black or very dark colored, soft, decomposed plant remains with considerable pale-brown to light yellowish brown plant fibers and generally enough clay, silt, and limesand or shell fragments to make the mass soft, sticky, and slightly gritty (wet), spongy and plastic (moist), and hard (dry). The muck is in some places overlain or interstratified with layers of silty clay a few inches to several inches thick. Light gray mottling is common in these clayey layers. Depth of the muck and interstratified clay ranged from 3 feet to more than 18 feet and averaged 7 feet, in a series of random samples. Average thickness of the muck, minus the clay layers, was 6 feet. Grains of limesand and whole or broken shells are noticeable at depths of 3 to 5 feet and, in the coastal or adjacent alluvial flats, comprise the predominant material immediately underlying the muck. The water table is at or near the surface most of the time. Reaction of the permanently saturated soil is alkaline; reaction of the soil above the level of permanent saturation is neutral to moderately acid.

#### Unit 12. Shioya Soils

General Features. This unit consists of light-colored limesand 3 to 35 or more feet deep, generally with some loaminess (up to 11 percent fines) and slightly dark organic coloring developed in the surface or "A" horizon. The unit occupies discontinuous terraces along the coast, 1 to 10 meters above the sea. The soil is rapidly drained to the water table. Where present, in test holes to bedrock, the water table ranged from 5 to 25 feet below the surface. Underlying bedrock is chiefly limestone, but in southern Guam the unit grades downward into volcanic sediments or weathered volcanic bedrock in some places. Narrow strips of beach (white limesand) are not separated out of this unit.

Unit 13. Limestone rock land

General Features. This unit is separated on the map into subunits 13b and 13f on the basis of important differences in prevailing surface gradients. Except for this marked difference in slope, the subunits may be described as one. Patches of reddish or brownish granular clay, generally very shallow, are interspersed among exposures of limestone bedrock, pinnacles, boulders, and fragments which occupy more than 25 percent of the entire area and more than 75 percent of local areas of this unit.

Appendix C: Water Available on the Southern Part of Guam <sup>1/</sup>

1. Talofoyo River, near Talofoyo  
Drainage area - 16.2 square miles  
Elevation 30 feet  
Average Discharge 56.8 c.f.s.  
Maximum 8740 c.f.s.  
Minimum .78 c.f.s.
2. Almagosa Springs, near Agat  
Area - .7 square miles  
Elevation 620 feet  
Average Discharge 4.80 c.f.s.  
Maximum 1220 c.f.s.  
Minimum not always continuous
3. Maemong River, near Agat  
Area - 6.5 square miles  
Elevation 52 feet  
Average Discharge not determined  
Maximum not determined  
Minimum .25 c.f.s.
4. Ylig River, near Yona  
Area - 5.9 square miles  
Elevation 20 feet  
Average Discharge 26.8 c.f.s.  
Maximum 4060 c.f.s.  
Minimum .31 c.f.s.
5. Pago River, Ordot  
Area - 6.2 square miles  
Elevation 30 feet  
Average Discharge not determined  
Maximum 6000 c.f.s.  
Minimum .7 c.f.s.
6. Lonfit River, near Ordot  
Area - 3.1 square miles  
Elevation 35 feet  
Average Discharge not determined  
Maximum not determined  
Minimum less than .10 c.f.s.

<sup>1/</sup> From an unpublished report by C. H. Stensland and J. E. Paseur, U. S. Geological Survey.

- |                              |                |
|------------------------------|----------------|
| 7. Pauliluc River, Inarajan  |                |
| Area - 1.9 square miles      |                |
| Elevation                    | 30 feet        |
| Average Discharge            | 7.52 c.f.s.    |
| Maximum                      | 3000 c.f.s.    |
| Minimum                      | .46 c.f.s.     |
|                              |                |
| 8. Inarajan, near Inarajan   |                |
| Area - 4.5 square miles      |                |
| Elevation                    | 20 feet        |
| Average Discharge            | 24.4 c.f.s.    |
| Maximum                      | 4600 c.f.s.    |
| Minimum                      | .89 c.f.s.     |
|                              |                |
| 9. Umatac River, Umatac      |                |
| Area - 2.0 square miles      |                |
| Elevation                    | 12 feet        |
| Average Discharge            | not determined |
| Maximum                      | 2500 c.f.s.    |
| Minimum                      | .37 c.f.s.     |
|                              |                |
| 10. Fouha River, near Umatac |                |
| Area - 1.1 square mile       |                |
| Elevation                    | 120 feet       |
| Average Discharge            | 4.72 c.f.s.    |
| Maximum                      | 1050 c.f.s.    |
| Minimum                      | .37 c.f.s.     |
|                              |                |
| 11. Geus River, near Merizo  |                |
| Area - .95 square mile       |                |
| Elevation                    | 100 feet       |
| Average Discharge            | 2.63 c.f.s.    |
| Maximum                      | 1870 c.f.s.    |
| Minimum                      | no flow        |

Appendix D: Tables

Table 1. Rainfall on Guam. 10-year average rainfall compared with rainfall in 1955 and 1956 <sup>1/</sup>

Month	10-Year Av.	1955	Month	10-Year Av.	1956
	<u>Inches</u>	<u>Inches</u>		<u>Inches</u>	<u>Inches</u>
July	12.33	15.55	January	3.18	2.29
August	14.71	7.50	February	2.92	2.82
September	14.77	6.07	March	2.67	2.14
October	12.85	8.82	April	2.01	2.38
November	8.10	7.08	May	4.16	5.59
December	4.96	4.13	June	4.97	3.11
TOTALS	67.72	49.15	TOTALS	19.91	18.33

<sup>1/</sup> Data from 20 representative weather stations.

Table 2. Total average rainfall at various elevations on Guam <sup>1/</sup>

Location	Approximate elevation	Total average annual precipitation
	<u>Feet</u>	<u>Inches</u>
Adelup Reservoir	250	82.49
Agana Springs	10	90.57
Agriculture Dept. Hdqrs.	200	90.19
Almagosa Springs	700	107.87
Andersen Air Force Base	520	85.57
Nimitz Hill	560	92.56
Fena River	50	97.66
Inarajan	100	74.65
Maamot	395	92.88
Mt. Tenjo	880	81.77
Naval Air Station, Agana	220	89.01
Naval Communications Station	340	90.63
Pago River	90	80.33
Iamuning (U.S.G.S. Hdqrs.)	30	86.01
Umatae	20	76.27

<sup>1/</sup> Data from U. S. Geological Survey.

Table 3. Population of Guam by villages as of June 30, 1956, excluding persons on military reservations <sup>1/</sup>

Municipality or district	Guamanians		Other Citizens		Aliens		Total		Total Number of Persons
	Male	Female	Male	Female	Male	Female	Male	Female	
Agana	360	424	42	37	110	50	512	511	1023
Agana Heights	900	968	254	219	63	21	1217	1208	2425
Agat	1112	1243	112	110	60	37	1284	1390	2674
Asan	590	660	92	89	30	20	712	769	1481
Barrigada	1846	1974	71	53	73	28	1990	2055	4045
Chalan Pago-Ordot Area	645	717	45	12	25	12	715	741	1456
Dededo	920	899	75	100	83	46	1078	1045	2123
Inarajan	756	806	8	2	8	-	772	808	1580
Mangilao	471	530	53	48	12	-	536	578	1114
Merizo	609	598	3	-	23	10	635	608	1243
Mongmond-Toto Area	808	769	119	113	44	18	971	900	1871
Fiti	557	618	41	32	112	69	710	719	1429
Santa Rita	739	830	43	21	10	7	792	858	1650
Sinajana	2005	2144	133	120	95	45	2233	2309	4542
Talofofo	543	546	4	3	32	29	579	578	1157
Tamuning-Tumon Area	994	983	524	443	832	217	2350	1643	3993
Umatac	330	345	-	-	1	-	331	345	676
Yigo	477	464	10	13	18	12	505	489	994
Yona	766	867	114	108	51	37	931	1012	1943
TOTAL	15428	16385	1743	1523	1682	658	18853	18566	37419

<sup>1/</sup> From Islandwide Census as of June 30, 1956, by Municipal Commission, Government of Guam.

Table 4. Number of farms of specified size on Guam and amount of land in farms of each size, 1950 1/  
(1 hectare = 2.471 acres)

Municipality	Total	Size of Farm										50 hectares and over
		Under 1 hectare	1 to 2 hectares	3 to 4 hectares	5 to 7 hectares	8 to 9 hectares	10 to 19 hectares	20 to 39 hectares	40 to 49 hectares			
		Number of farms										
Guam, all municipalities.....	2,262	860	660	341	152	59	119	50	5	16		
Agana.....	4	-	-	1	1	-	1	-	-	1		
Agat.....	205	125	40	16	9	5	7	2	-	1		
Asan.....	95	40	37	8	6	-	1	1	-	2		
Barrigada.....	561	222	127	114	40	12	33	7	1	5		
Dededo.....	87	6	17	13	9	16	17	8	-	1		
Inarajan.....	183	44	61	34	18	5	10	7	1	3		
Machanao.....	21	1	11	5	1	1	2	-	-	-		
Merizo.....	120	2	91	19	6	1	1	-	-	-		
Piti.....	86	64	10	7	4	-	-	1	-	-		
Sinajana.....	496	250	128	52	30	8	19	7	1	1		
Sumay.....	1	-	-	-	-	-	1	-	-	-		
Talofofo.....	94	27	39	13	3	5	3	4	-	-		
Umatac.....	68	5	40	15	5	1	2	-	-	-		
Yigo.....	101	16	22	25	10	4	14	7	2	1		
Yona.....	140	58	37	19	10	1	8	6	-	1		
-61-												
Guam, all municipalities.....	10,025	149	976	1,188	877	485	1,535	1,330	269	3,216		
Agana.....	1,333	-	-	4	6	-	16	-	-	1,307		
Agat.....	421	17	58	54	52	41	97	42	-	60		
Asan.....	446	4	50	29	33	-	10	20	-	300		
Barrigada.....	2,599	41	199	421	234	100	404	179	100	921		
Dededo.....	802	1	29	48	49	130	253	228	-	64		
Inarajan.....	962	6	89	115	110	41	119	207	40	235		
Machanao.....	72	-	16	16	6	9	25	-	-	-		
Merizo.....	244	1	129	64	32	8	10	-	-	-		
Piti.....	83	4	14	22	23	-	-	20	-	-		
Sinajana.....	1,198	59	191	179	183	66	250	174	46	50		
Sumay.....	14	-	-	-	-	-	14	-	-	-		
Talofofo.....	328	5	65	40	15	41	38	124	-	-		
Umatac.....	169	2	60	51	26	8	22	165	-	-		
Yigo.....	686	4	28	80	54	33	169	83	83	70		
Yona.....	668	5	48	65	54	8	108	171	-	209		

1/ From 1950 U. S. Census.

Table 5. Farms reporting and field crops harvested  
in 1949 on Guam <sup>1/</sup>

Crop	Number of farms reporting crop	Pounds harvested
Arrowroot	35	3,461
Cassava	67	15,710
Corn	660	571,413
Melons	141	61,764
Sugarcane	98	23,152
Sweetpotatoes	178	107,044
Taro	521	280,742
Tobacco	14	965
Yams	264	87,283
Beans	160	33,072
Peppers	49	3,686
Tomatoes	47	13,628
Cabbage	12	615
Cucumbers	39	20,475
Radishes	19	15,150
Eggplant	20	2,869

<sup>1/</sup> From 1950 U. S. Census of Agriculture.

Table 6. Farms reporting and fruits and nuts harvested in 1949 on Guam 1/

Commodity	Number of farms reporting any	Amount harvested
Avocados	493	67,064
Bananas	1,259	65,266*
Breadfruit	815	371,589
Coconuts	1,213	3,172,106
Coffee	165	2,465#
Grapefruit	28	975
Kapok	148	1,131#
Lemons	368	54,987
Limes	66	7,941
Mangoes	461	428,072
Oranges	282	25,003
Tangerines	404	74,713
Papayas	178	10,504
Pineapples	169	10,726
* Bunches		
# Pounds		

1/ From 1950 U. S. Census of Agriculture.





